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EMC TEST REPORT

Report No: STS1703034E01

Issued for

Shanwei Express Communication & Navigation Company Ltd.

zhongyang building, publan Industrial ZONE, hongcao
town, shanwei city guangdong province, 516600. P.R. China

Product Name:	7" COLOR LCD FISH FINDER
Brand Name:	ONWA
Test Model Name:	KFish-7
Series Model:	N/A
Test Standard:	EN 60945:2002

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Test Report Certification

Applicant's name : Shanwei Express Communication & Navigation Company Ltd.

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Manufacture's Name : Shanwei Express Communication & Navigation Company Ltd.

Address : zhongyang building, publan Industrial ZONE, hongcao town, shanwei city guangdong province, 516600. P.R. China

Product description

Product name : 7" COLOR LCD FISH FINDER

Trademark : ONWA

Model and/or type reference : KFish-7

Serial Model : N/A

Standards : EN 60945:2002

This device described above has been tested by STS, and the test results show that the equipment under test (EUT) is in compliance with the EMC Directive 2014/30/EU requirements. And it is applicable only to the tested sample identified in the report.

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Date of Test :

Date (s) of performance of tests : 21 Mar. 2017 ~26 Mar. 2017

Date of Issue : 27 Mar. 2017

Test Result : **Pass**

Testing Engineer :

Barry Li

(Barry Li)

Technical Manager :

Chopin Xiao

(Chopin Xiao)

Authorized Signatory :

Vita Li

(Vita Li)





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**Revision History**

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	27 Mar. 2017	STS1703034E01	ALL	Initial Issue
Note: Format version of the report -V01				





1. TEST SUMMARY

Test procedures according to the technical standards:

EN 60945

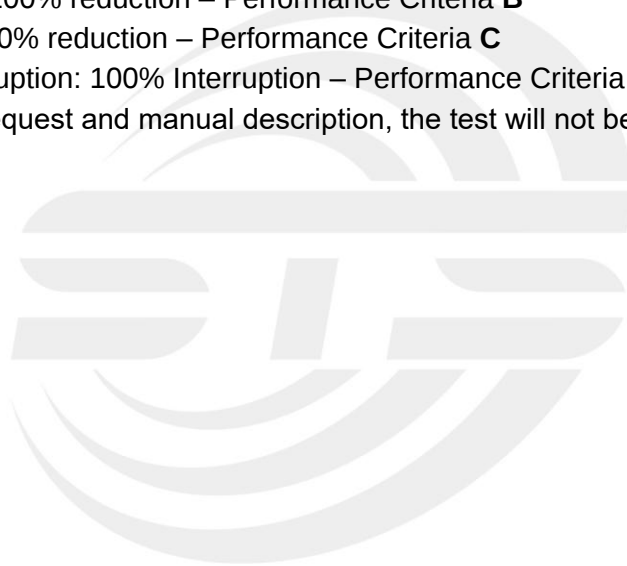
DURABILITY AND RESISTANCE TO ENVIRONMENTAL CONDITIONS				
	Portable	Protected	Exposed	Submerged
Dry heat	+55 °C (storage +70 °C)	+55 °C	+55 °C (storage +70 °C)	(storage +70 °C)
Damp heat	+40 °C 93 % relative humidity 1 cycle			*
Low temperature	−20 °C (storage −30 °C)	−15 °C	−25 °C	*
Thermal shock	45 K into water	*		
Drop onto hard surface	6 drops from 1 m	*		
Drop into water	3 drops from 20 m	*		
Vibration	Sweep 2 Hz – 13.2 Hz at ± 1 mm, 13.2 Hz – 100 Hz at 7 m/s ² and for 2 h on each resonance, otherwise 2 h at 30 Hz in all three axes			
Rain and spray	*	*	12.5 mm nozzle 100 l/min at 3 m	*
Water immersion	100 kPa (1 bar) for 5 min 10 kPa (0.1 bar) for two-way VHF	*		600 kPa (6 bar) for 12 h
Solar radiation	1120 W/m ² 80 h	*	*	*
Oil resistance	ISO Oil No. 1 24 h, 19 °C	*	*	*
Corrosion	Four periods of seven days at 40 °C with 90 % – 95 % relative humidity after 2 h salt spray			
EMC Emission				
Standard EN 60945:2002	Test Item	Limit	Judgment	Remark
EN 60945:2002	Conducted emissions (9.2)	-----	N/A	NOTE (1)
	Radiated emissions (9.3)	-----	PASS	
EN 61000-3-2:2006/2009	Harmonic Current Emission	Class A or D NOTE (2)	N/A	
EN 61000-3-3:2008	Voltage Fluctuations & Flicker	-----	N/A	
EMC Immunity				
Section EN 60945:2002	Test Item	Performance Criteria	Judgment	Remark
IEC 61000-4-2:1995	Electrostatic discharge (10.9)	B	PASS	
IEC 61000-4-3:1995	Radiated disturbance (10.4)	A	PASS	



IEC 61000-4-4:1995	Fast transients (bursts) (10.5)	B	N/A	
IEC 61000-4-5:1995	Slow transients (surges)(10.6)	B	N/A	
IEC 61000-4-6:1996	Conducted radio frequency disturbance (10.3)	A	PASS	
IEC 61000-4-11:1994	Power supply short term variation (10.7)	B / C / C NOTE (3)	N/A	
IEC 61000-4-11:1994	Power supply failure (10.8)	B / C / C NOTE (3)	N/A	

NOTE:

- (1) "N/A" denotes test is not applicable in this Test Report
- (2) The power consumption of EUT is less than 75W and no Limits apply.
- (3) Voltage dip: 100% reduction – Performance Criteria **B**
Voltage dip: 30% reduction – Performance Criteria **C**
Voltage Interruption: 100% Interruption – Performance Criteria **C**
- (4) For client's request and manual description, the test will not be executed.





1.1 TEST FACILITY

Shenzhen STS Test Services Co., Ltd.

Add.: 1/F, Building 2, Zhuoke Science Park, Chongqing Road, Fuyong, Bao'an District, Shenzhen, China

CNAS Registration No.: L7649;

FCC Registration No.: 842334;

IC Registration No.: 12108A-1

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expanded uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately **95** %.

A. Conducted Measurement :

Test Site	Method	Measurement Frequency Range	U , (dB)	NOTE
STSC01	ANSI	150 KHz ~ 30MHz	3.18	

B. Radiated Measurement :

Test Site	Method	Measurement Frequency Range	U , (dB)	NOTE
STSC02	ANSI	30MHz ~ 1000MHz	4.7	
		1GHz ~ 6 GHz	5.0	



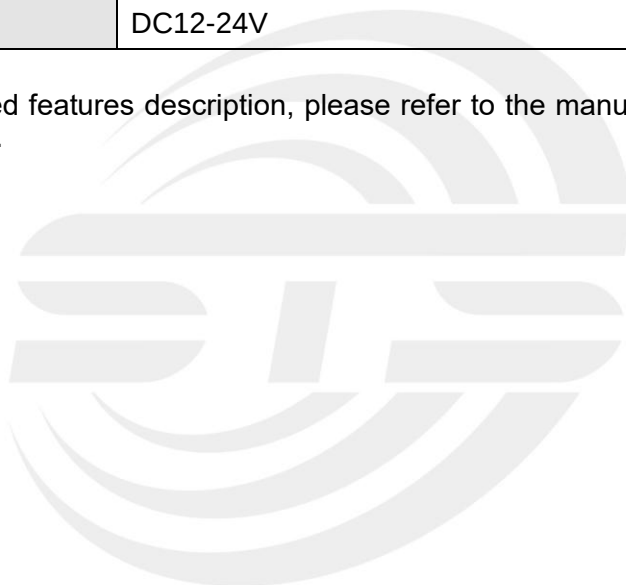
2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Equipment	7" COLOR LCD FISH FINDER
Brand Name	ONWA
Model Name.	KFish-7
Serial Model	N/A
Model Difference	N/A
Product Description	The EUT is 7" COLOR LCD FISH FINDER Based on the application, features, or specification exhibited in User's Manual, the EUT is considered as an 7" COLOR LCD FISH FINDER Device. More details of EUT technical specification, please refer to the User's Manual.
Power Rating	DC12-24V

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.





2.2 DESCRIPTION OF TEST MODES

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

To investigate the maximum EMI emission characteristics generated from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possibly have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	WORKING

For Conducted Test	
Final Test Mode	Description
Mode 1	WORKING

For Radiated Test	
Final Test Mode	Description
Mode 1	WORKING

For EMS Test	
Final Test Mode	Description
Mode 1	WORKING

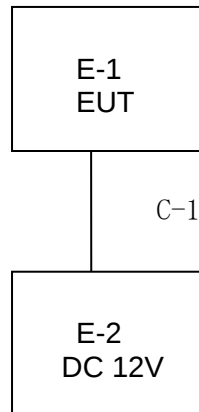
NOTE: The test modes were carried out for all operation modes(include link and idle).The final test mode of the EUT was the worst test mode for EMI, and its test data was showed.



2.3 DESCRIPTION OF TEST SETUP

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

7" COLOR LCD FISH FINDER





2.4 DESCRIPTION TEST PERIPHERAL AND EUT PERIPHERAL

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
E-1	7" COLOR LCD FISH FINDER	ONWA	KFish-7	N/A	EUT
E-2	DC 12V	N/A	N/A	N/A	N/A

Item	Shielded Type	Ferrite Core	Length	Note
C-1	NO	NO	1.5m	N/A

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.



2.5 MEASUREMENT INSTRUMENTS LIST

2.5.1 CONDUCTED TEST SITE

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
EMI Test Receiver	R&S	ESPI	102086	2016.10.23	2017.10.22
LISN	R&S	ENV216	101242	2016.10.23	2017.10.22
LISN	EMCO	3810/2NM	000-23625	2016.10.23	2017.10.22
Absorbing clamp	R&S	MDS-21	100668	2016.10.23	2017.10.22

2.5.2 RADIATED TEST SITE

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibration	Calibrated Until
EMI Test Receiver	R&S	ESCI	101427	2016.10.23	2017.10.22
Bilog Antenna	TESEQ	CBL6111D	34678	2014.11.24	2017.11.23
Horn Antenna	SCHWARZBECK	BBHA 9120D(1201)	9120D-1343	2015.03.05	2018.03.04
Power Amplifier	Agilent	8449B	60538	2016.10.23	2017.10.22
Spectrum Analyzer	Agilent	E4407B	MY50140340	2016.10.23	2017.10.22

2.5.3 HARMONICS AND FLICKER

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Harmonic Voltage & Flicker	LAPLACE	AC 2000A	3112217	2016.10.23	2017.10.22
AC Power Source	MTONI	PHF-5010	631169	2016.10.23	2017.10.22

2.5.4 ESD

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
ESD TEST GENERATOR	HTEC	HESD30	143802	2016.10.23	2017.10.22

2.5.5 SURGE, EFT/BURST, VOLTAGE INTERRUPTION/DIPS

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Surger Generator	HTEC	HCWG71	143804	2016.10.23	2017.10.22
Surger Generator	HTEC	SCDN161P	143805	2016.10.23	2017.10.22
VOLTAGE DIPS & INTERRUPTIONS Generator	HTEC	HPFS 161P	143803	2016.10.23	2017.10.22
EFT/B Generator	HTEC	HEFT 51	143801	2016.10.23	2017.10.22

3. EMC EMISSION TEST

During the measurements for electromagnetic emission, the EUT shall operate under normal test conditions, and the setting of controls which may affect the level of conducted or radiated emission shall be varied in order to ascertain the maximum emission level. If the EUT has more than one energized state, for example operate, stand-by, etc., the state which produces the maximum emission level shall be ascertained, and full measurements for that state shall be made. The antenna connection of the EUT, if any, shall be terminated in a non-radiating artificial antenna.

For radiated emission tests, equipment including a radio transmitter operating within the measurement bands shall be in the operational state but not the transmitting state.

For conducted emission tests with equipment including a radio transmitter, there shall be an exclusion band of 200 kHz centred at the fundamental and any harmonics within the measurement band.

Particular interfaces of the EUT with the external electromagnetic environment are referred to as ports. The physical boundary of the EUT through which electromagnetic fields may radiate or impinge is the enclosure port(as below)

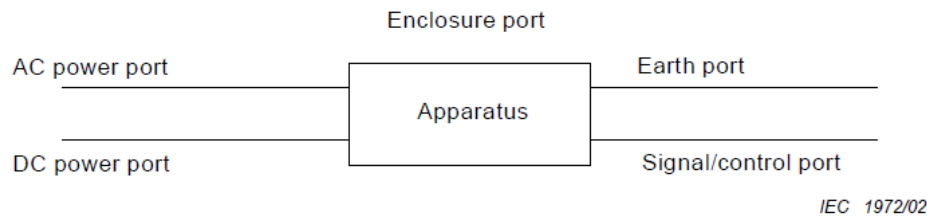


Figure 1 – Examples of ports referred to in electromagnetic emission and immunity tests



3.1 CONDUCTED EMISSIONS (9.2)

3.1.1 POWER LINE CONDUCTED EMISSION

(Frequency Range 10KHz-30MHz)

FREQUENCY (MHz)	Class A (dBuV)
	Quasi-peak
0.01 -0.15	96 dB μ V – 50 dB μ V
0.15 -0.35	60 dB μ V – 50 dB μ V
0.35 -30.0	50 dB μ V

Note:

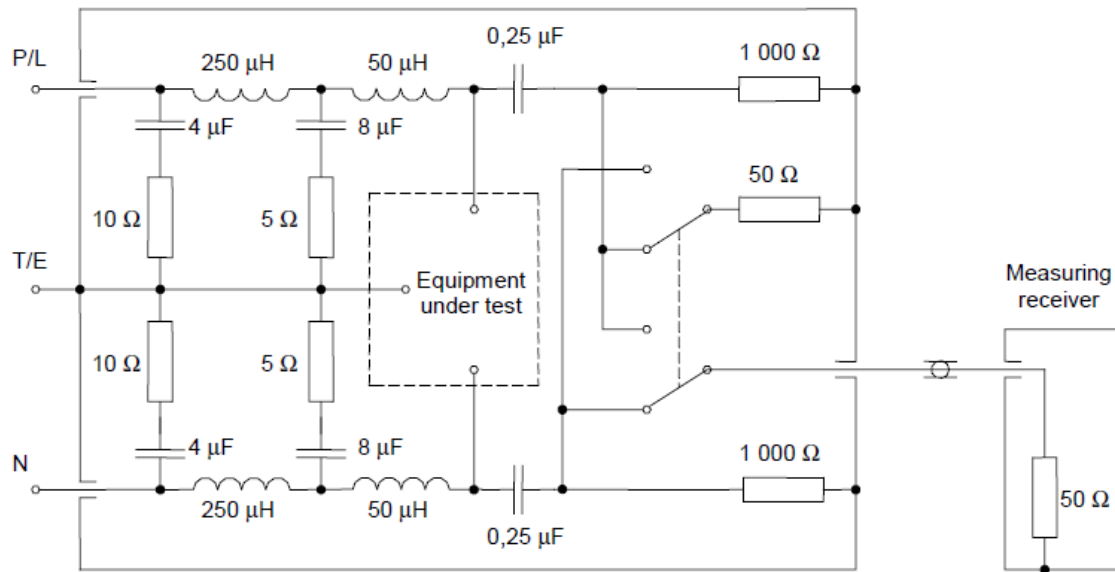
- (1) The tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

The following table is the setting of the receiver

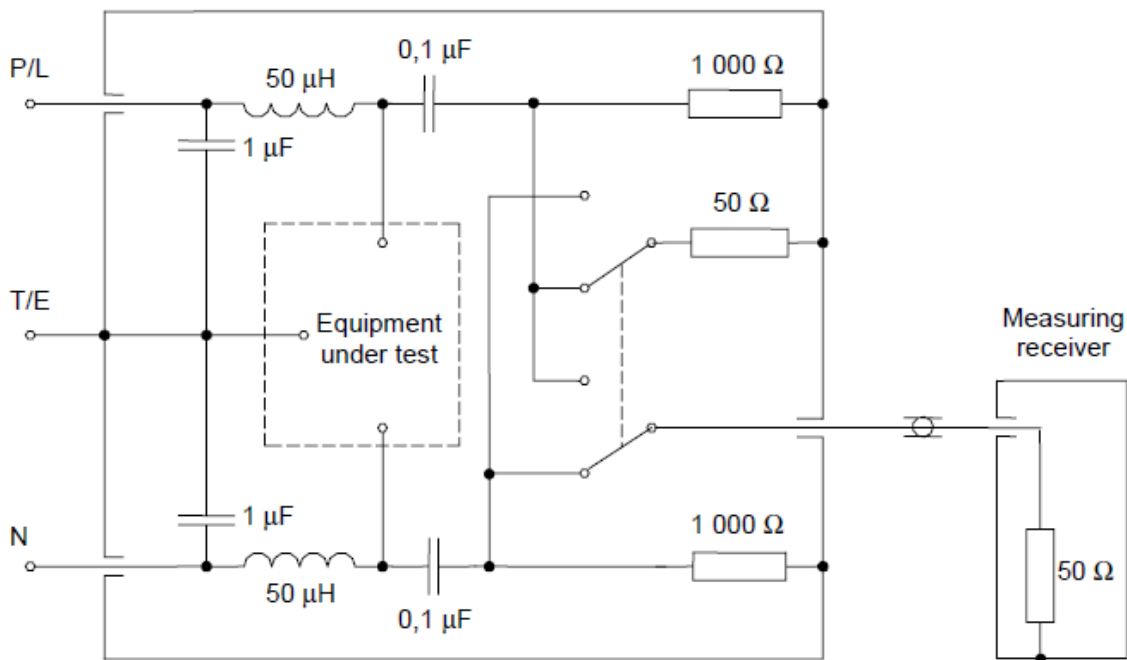
Receiver Parameters	Setting
Attenuation	10 dB
Start/Stop Frequency	0.01-0.15 MHz
IF Bandwidth	200 Hz
Start/Stop Frequency	0.15-30 MHz
IF Bandwidth	9 kHz

3.1.2 TEST PROCEDURE

- a. The emission shall be measured by means of the quasi-peak measuring receivers specified in CISPR 16-1. An artificial mains V-network (figure 2) in accordance with CISPR 16-1 shall be used to provide a defined impedance at high frequencies across the terminals of the EUT, and to isolate the test circuit from unwanted radio frequency signals on the supply mains. The measuring bandwidth in the frequency range 10 kHz to 150 kHz shall be 200 Hz, and in the frequency range 150 kHz to 30 MHz shall be 9 kHz.
- b. The power input cables between the a.c. and the d.c. power ports of the EUT and the artificial mains network shall be screened and not exceed 0,8 m in length. If the EUT consists of more than one unit with individual a.c. and/or d.c. power ports, power ports of identical nominal supply voltage may be connected in parallel to the artificial mains supply network.
- c. Measurements shall be made with all measuring equipment and the EUT mounted on, and bonded to, an earth plane. Where provision of an earth plane is not practicable, equivalent arrangements shall be made using the metallic frame or mass of the EUT as the earth reference.
- d. LISN at least 80 cm from nearest part of EUT chassis.
- e. For the actual test configuration, please refer to the related Item –EUT Test Photos.



artificial mains 50 Ω/50 μH + 5 Ω V-network for use in the frequency range 10 kHz to 150 kHz



artificial mains 50 Ω/50 μH V-network for use in the frequency range 150 kHz to 30 MHz

3.1.3 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.2 Unless otherwise a special operating condition is specified in the follows during the testing.



3.1.4 TEST RESULTS

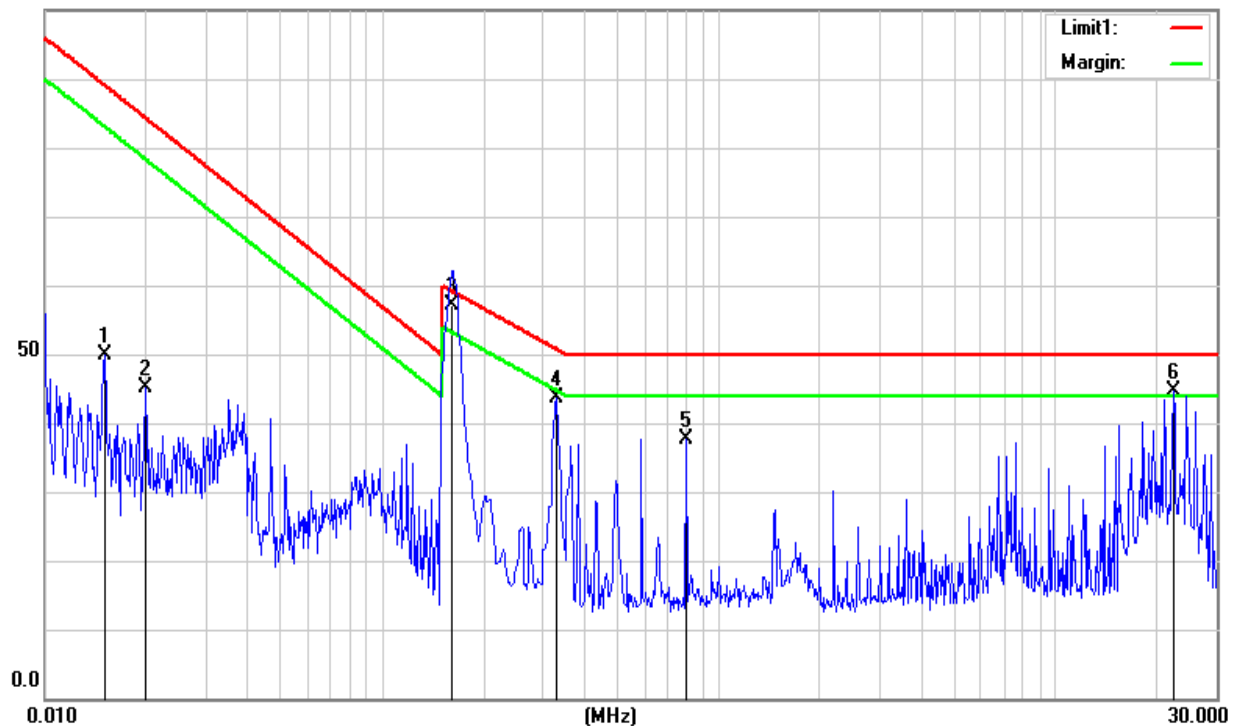
EUT :	7" COLOR LCD FISH FINDER	Model Name. :	KFish-7
Temperature :	22.4 °C	Relative Humidity :	59%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 12V	Test Mode :	Mode 1

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.0150	40.26	9.71	49.97	89.11	-39.14	QP
2	0.0200	35.52	9.61	45.13	84.23	-39.10	QP
3	0.1621	47.83	9.23	57.06	59.08	-2.02	QP
4	0.3301	34.35	9.16	43.51	50.69	-7.18	QP
5	0.7980	28.41	9.25	37.66	50.00	-12.34	QP
6	22.3500	34.89	9.83	44.72	50.00	-5.28	QP

Remark:

1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result = Reading + Factor) – Limit

100.0 dBuV





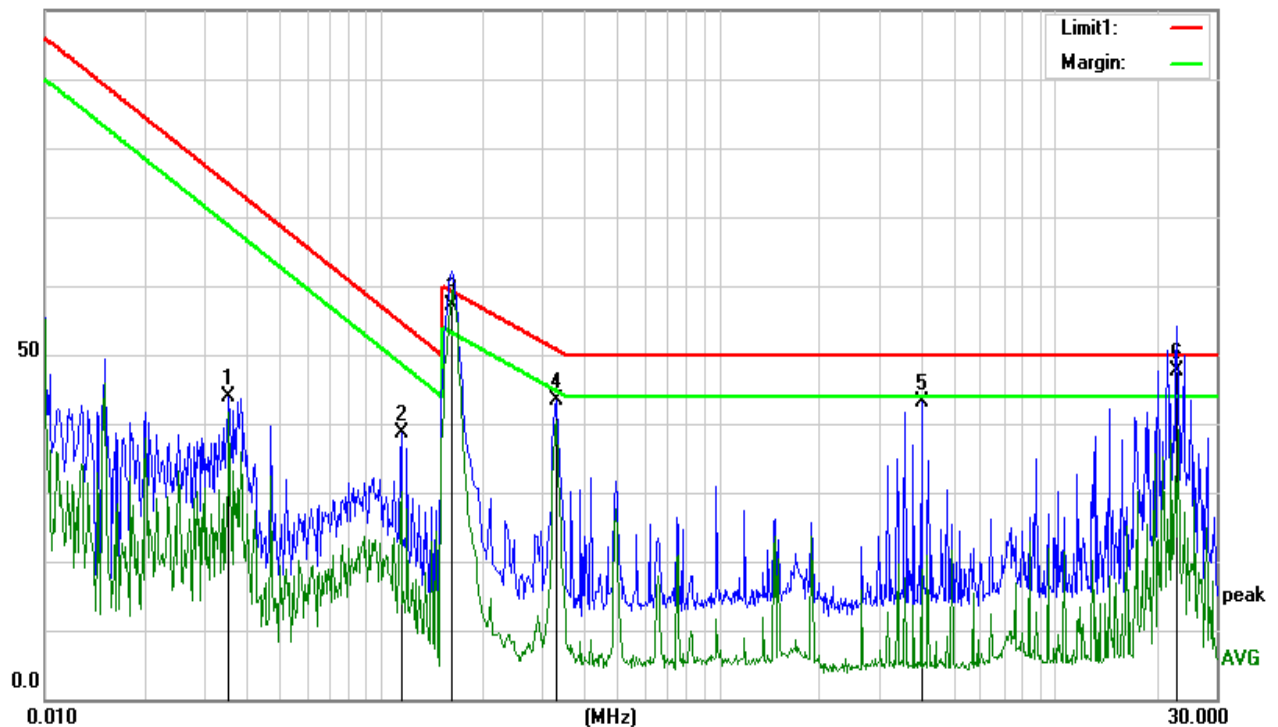
EUT :	7" COLOR LCD FISH FINDER	Model Name. :	KFish-7
Temperature :	22.4 °C	Relative Humidity :	59%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 12V	Test Mode :	Mode 1

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.0350	34.35	9.46	43.81	74.72	-30.91	QP
2	0.1140	29.32	9.22	38.54	54.66	-16.12	QP
3	0.1621	47.84	9.23	57.07	59.08	-2.01	QP
4	0.3300	34.16	9.16	43.32	50.69	-7.37	QP
5	3.9900	33.79	9.26	43.05	50.00	-6.95	QP
6	22.9540	37.84	9.84	47.68	50.00	-2.32	QP

Remark:

1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result = Reading + Factor) – Limit

100.0 dBuV





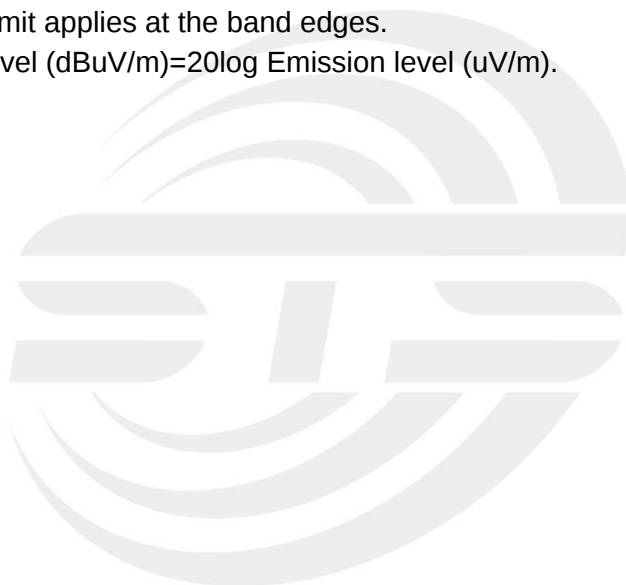
3.2 RADIATED EMISSIONS (9.3)

3.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT

FREQUENCY (MHz)	Class A (at 10m)
	dBuV/m
0.15-0.3(magnetic H field)	80 to 52
0.3-30(magnetic H field)	52 to 34
30-156	54
156-165	24
165-2000	54

Notes:

- (1) The limit for radiated test was performed according to as following:
EN 60945
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).





3.2.2 TEST PROCEDURE

- a. The quasi-peak measuring receivers specified in CISPR 16-1 shall be used. The receiver bandwidth in the frequency ranges 150 kHz to 30 MHz shall be 9 kHz and in the frequency ranges 30 MHz to 2 GHz shall be 120 kHz.

For frequencies from 150 kHz to 30 MHz measurements shall be made of the magnetic H field. The measuring antenna shall be an electrically screened loop antenna of dimension so that the antenna can be completely enclosed by a square having sides of 60 cm in length, or an appropriate ferrite rod as described in CISPR 16-1.

The correction factor for the antenna shall include the factor +51,5 dB to convert the magnetic field strength to equivalent electric field strength.

For frequencies above 30 MHz measurements shall be made of the electric E field. The measuring antenna shall be a balanced dipole of resonant length, or alternate shortened dipole or higher gain antenna as described in CISPR 16-1. The dimension of the measuring antenna in the direction of the EUT shall not exceed 20 % of its distance from the EUT. At frequencies above 80 MHz it shall be possible to vary the height of the centre of the measuring antenna above the ground over a range of 1 m to 4 m.

The test site shall be compliant with CISPR 16-1, using a metal ground plane and of dimensions to allow a measurement distance of 3 m.

The EUT shall be fully assembled, complete with its associated interconnecting cables and mounted in its normal plane of operation

When the EUT consists of more than one unit, the interconnecting cables (other than antenna feeders) between the main unit and all other units shall be the maximum length as specified by the manufacturer or 20 m whichever is shorter. Available input and output ports shall be connected to the maximum length of cable as specified by the manufacturer or 20 m whichever is shorter, and terminated to simulate the impedance of the ancillary equipment to which they are normally connected.

The excess length of these cables shall be bundled at the approximate centre of the cable with bundles 30 cm to 40 cm in length running in the horizontal plane from the port to which they are connected. If it is impractical to do so because of cable bulk or stiffness, the disposition of the excess cable shall be as close as possible to that required, and shall be precisely described in the test report.

The test antenna shall be placed at a distance of 3 m from the EUT. The centre of the antenna shall be at least 1,5 m above the ground plane. The E-field antenna only shall be adjusted in height and rotated to give horizontal and vertical polarization, one being parallel to the ground, in order to determine the maximum emission level. Finally the antenna shall either be moved around the EUT, again in order to determine the maximum emission level, or alternatively, the EUT may be placed on a plane orthogonal to the test antenna at its mid-point and rotated to achieve the same effect.

- b. The test antenna shall be placed at a distance of 3 m from the EUT. The centre of the antenna shall be at least 1,5 m above the ground plane. The E-field antenna only shall be adjusted in height and rotated to give horizontal and vertical polarization, one being parallel to the ground, in order to determine the maximum emission level. Finally the antenna shall either be moved around the EUT, again in order to determine the maximum emission level, or alternatively, the EUT may be placed on a plane orthogonal to the test antenna at its mid-point and rotated to achieve the same effect.
- c. Alternatively, for the frequency band 156 MHz to 165 MHz, a peak receiver or a frequency analyzer may be used, in accordance with the agreement between the manufacturer and the test house.



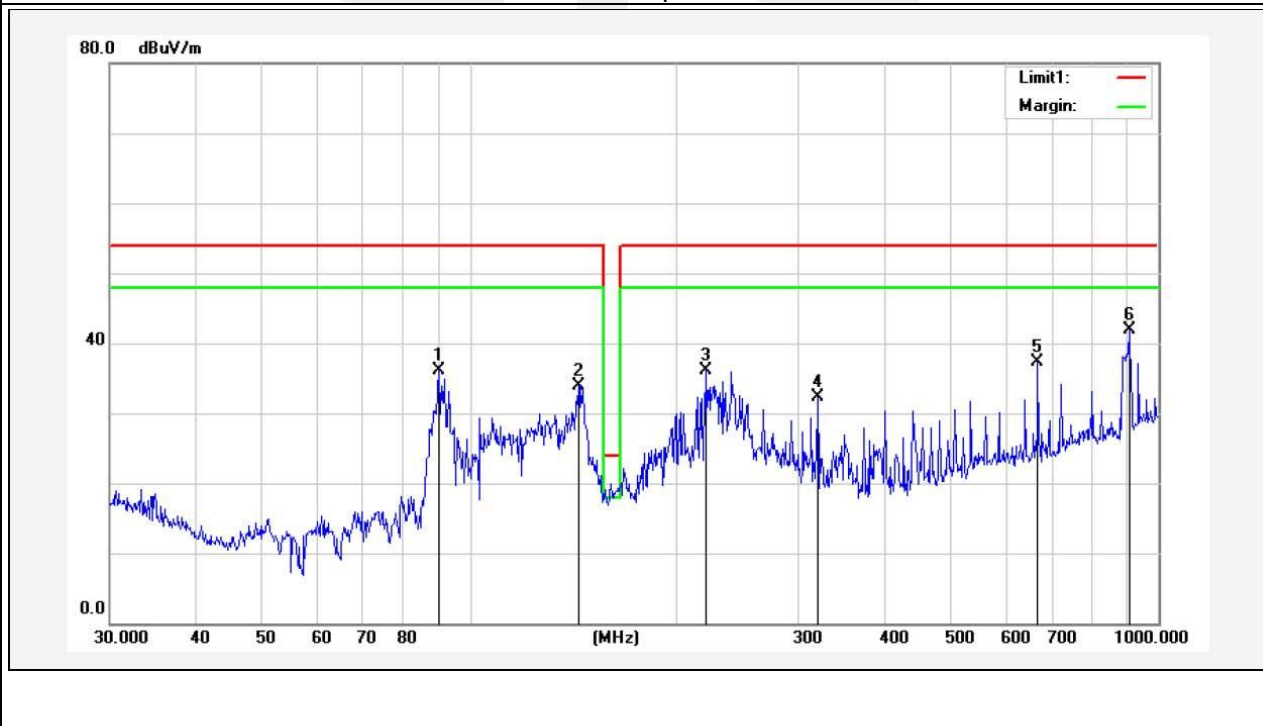
3.2.3 TEST RESULTS (30 -1000 MHz)

EUT :	7" COLOR LCD FISH FINDER	Model Name :	KFish-7
Temperature :	25℃	Relative Humidity :	54%
Pressure :	1010 hPa	Polarization :	Horizontal
Test Power :	DC 12V	Test Mode :	Mode 1

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
90.2205	56.25	-20.18	36.07	54.00	-17.93	QP
143.8293	51.60	-17.69	33.91	54.00	-20.09	QP
220.6170	55.21	-19.08	36.13	54.00	-17.87	QP
319.9370	46.53	-14.17	32.36	54.00	-21.64	QP
668.1422	43.36	-6.05	37.31	54.00	-16.69	QP
906.4823	43.95	-2.05	41.90	54.00	-12.10	QP

Remark:

1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.



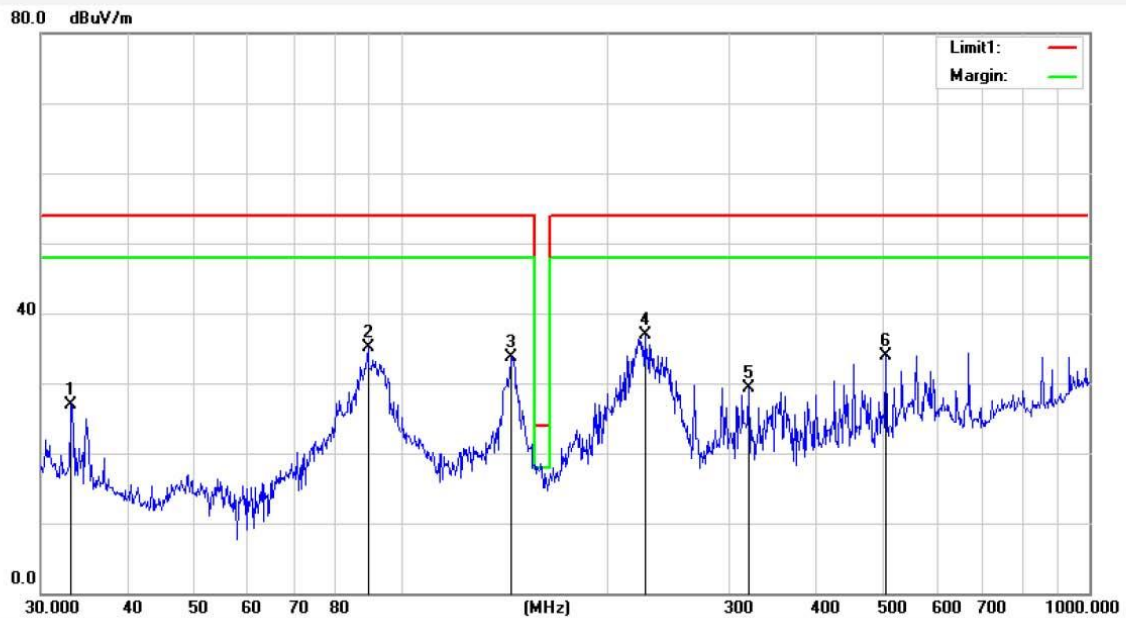


EUT :	7" COLOR LCD FISH FINDER	Model Name :	KFish-7
Temperature :	25 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Polarization :	Vertical
Test Power :	DC 12V	Test Mode :	Mode 1

Frequency	Reading	Correct	Result	Limit	Margin	Remark
(MHz)	(dBuV)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
33.2111	39.70	-12.84	26.86	54.00	-27.14	QP
89.5900	55.33	-20.30	35.03	54.00	-18.97	QP
144.8418	51.39	-17.74	33.65	54.00	-20.35	QP
226.0994	55.57	-18.72	36.85	54.00	-17.15	QP
319.9370	43.48	-14.17	29.31	54.00	-24.69	QP
506.4791	42.88	-8.89	33.99	54.00	-20.01	QP

Remark:

1. Factor = Antenna Factor + Cable Loss – Pre-amplifier.





3.2.4 TEST RESULTS (1000 - 6000 MHz)

EUT :	7" COLOR LCD FISH FINDER	Model Name :	KFish-7
Temperature :	25 °C	Relative Humidity :	54 %
Pressure :	1010 hPa	Test Mode :	Mode 1
Test Power :	DC 12V		

Polar	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(H/V)	(MHz)	(dBm)	(dB)	(dBm)	(dBm)	(dB)	
V	1750.44	73.42	-10.98	62.44	70.00	-7.56	PK
V	1750.44	52.89	-10.98	41.91	50.00	-8.09	AVG
V	2122.79	65.80	-10.54	55.26	70.00	-14.74	PK
V	2122.79	51.60	-10.54	41.06	50.00	-8.94	AVG
H	1750.56	67.15	-11.52	55.63	70.00	-14.37	PK
H	1750.56	55.52	-11.52	44.00	50.00	-6.00	AVG
H	2150.34	65.65	-10.08	55.57	70.00	-14.43	PK
H	2150.34	53.85	-10.08	43.77	50.00	-6.23	AVG
Remark:							
Absolute Level= ReadingLevel+ Factor, Margin= Absolute Level - Limit							



4. EMC IMMUNITY TEST

4.1 GENERAL PERFORMANCE CRITERIA

4.1.1 PERFORMANCE CRITERIA

Criteria	During the test
A	the EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specification published by the manufacturer;
B	the EUT shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance which is self-recoverable is however, allowed, but no change of actual operating state or stored data is allowed.
C	temporary degradation or loss of function or performance is allowed during the test, provided the function is self-recoverable, or can be restored at the end of the test by the operation of the controls, as defined in the relevant equipment standard and in the technical specification published by the manufacturer.

NOTE 1: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 2: no degradation of performance after the test is understood as any degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

4.1.2 GENERAL PERFORMANCE CRITERIA TEST SETUP

The EUT tested system was configured as the statements of **2.2** Unless otherwise a special operating condition is specified in the follows during the testing.



4.2 ELECTROSTATIC DISCHARGE (10.9)

4.2.1 TEST SPECIFICATION

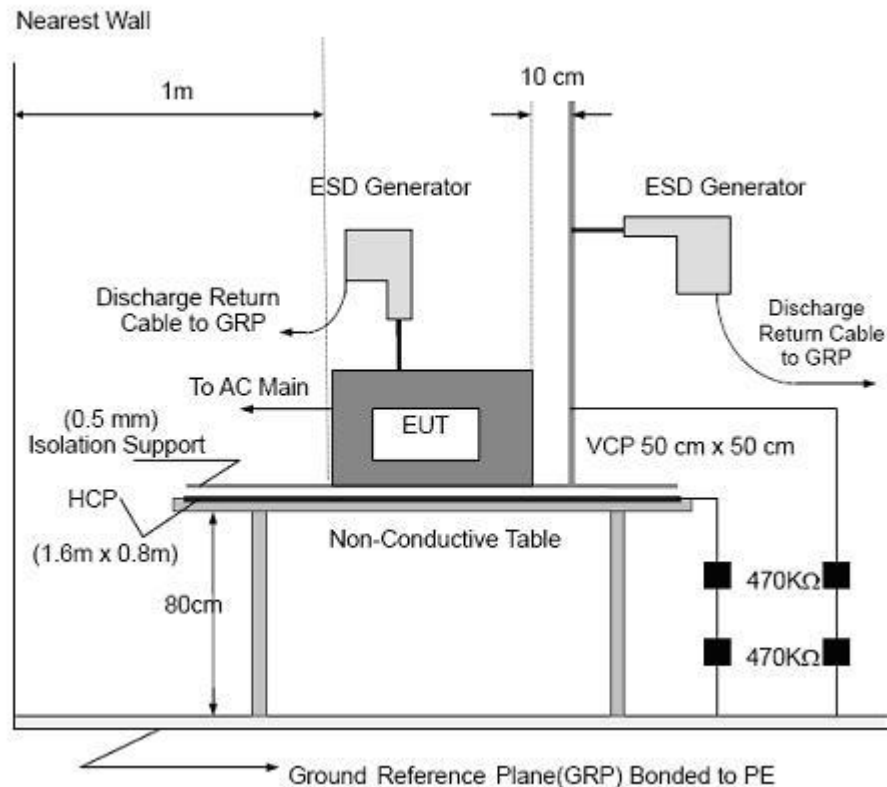
Basic Standard:	IEC/EN 61000-4-2
Discharge Impedance:	330 ohm / 150 pF
Required Performance	B
Discharge Voltage:	Air Discharge:2kV/4kV/8kV (Direct) Contact Discharge:2kV/4 kV/6 kV (Direct/Indirect)
Polarity:	Positive & Negative
Number of Discharge:	Air Discharge: min. 20 times at each test point Contact Discharge: min. 200 times in total
Discharge Mode:	AC Discharge
Discharge Period:	1 second minimum

4.2.2 TEST PROCEDURE

The test shall be carried out as described in EN 61000-4-2 using an electrostatic discharge (ESD) generator, that is an energy storage capacitance of 150 pF and a discharge resistance of 330 Ω connected to a discharge tip.

- a. The EUT shall be placed on, but insulated from, a metal ground plane which projects at least 0,5 m beyond the EUT on all sides (figures 11 and 12). Discharges from the generator shall be applied to those points and surfaces that are accessible to personnel during normal usage.
- b. The ESD generator shall be held perpendicular to the surface, and the positions at which discharges can be applied selected by an exploration with 20 discharges per second. Each position shall then be tested with 10 discharges positive and negative with intervals of at least 1 s between discharges to allow for any mis-operation of the EUT to be observed. Contact discharge is the preferred method; but air discharge shall be used where contact discharge cannot be applied, such as on painted surfaces declared by the manufacturer to be insulating.
- c. In order to simulate discharges on objects placed or installed near to the EUT, 10 single contact discharges, positive and negative, shall be applied to the ground plane at positions on each side of and 0.1 m from, the EUT. A further 10 discharges shall be applied to the centre of one edge of a vertical coupling plane (VCP), with this plane in enough different positions so that the four faces of the EUT are completely illuminated
- d. The test levels shall be 6 kV contact discharge and 8 kV air discharge.

4.2.3 TEST SETUP



Note:

TABLE-TOP EQUIPMENT

The configuration consisted of a wooden table 0.8 meters high standing on the Ground Reference Plane. The GRP consisted of a sheet of aluminum at least 0.25mm thick, and 2.5 meters square connected to the protective grounding system. A Horizontal Coupling Plane (1.6m x 0.8m) was placed on the table and attached to the GRP by means of a cable with 940k total impedance. The equipment under test, was installed in a representative system as described in section 7 of IEC /EN 61000-4-2, and its cables were placed on the HCP and isolated by an insulating support of 0.5mm thickness. A distance of 1-meter minimum was provided between the EUT and the walls of the laboratory and any other metallic structure.

FLOOR-STANDING EQUIPMENT

The equipment under test was installed in a representative system as described in section 7 of IEC/EN 61000-4-2, and its cables were isolated from the Ground Reference Plane by an insulating support of 0.1-meter thickness. The GRP consisted of a sheet of aluminum that is at least 0.25mm thick, and 2.5meters square connected to the protective grounding system and extended at least 0.5 meters from the EUT on all sides.



4.2.4 TEST RESULTS

EUT :	7" COLOR LCD FISH FINDER	Model Name :	KFish-7
Temperature :	21.6℃	Relative Humidity :	49%
Pressure :	1010 hPa	Test Power :	DC 12V
Test Mode	Mode 1		

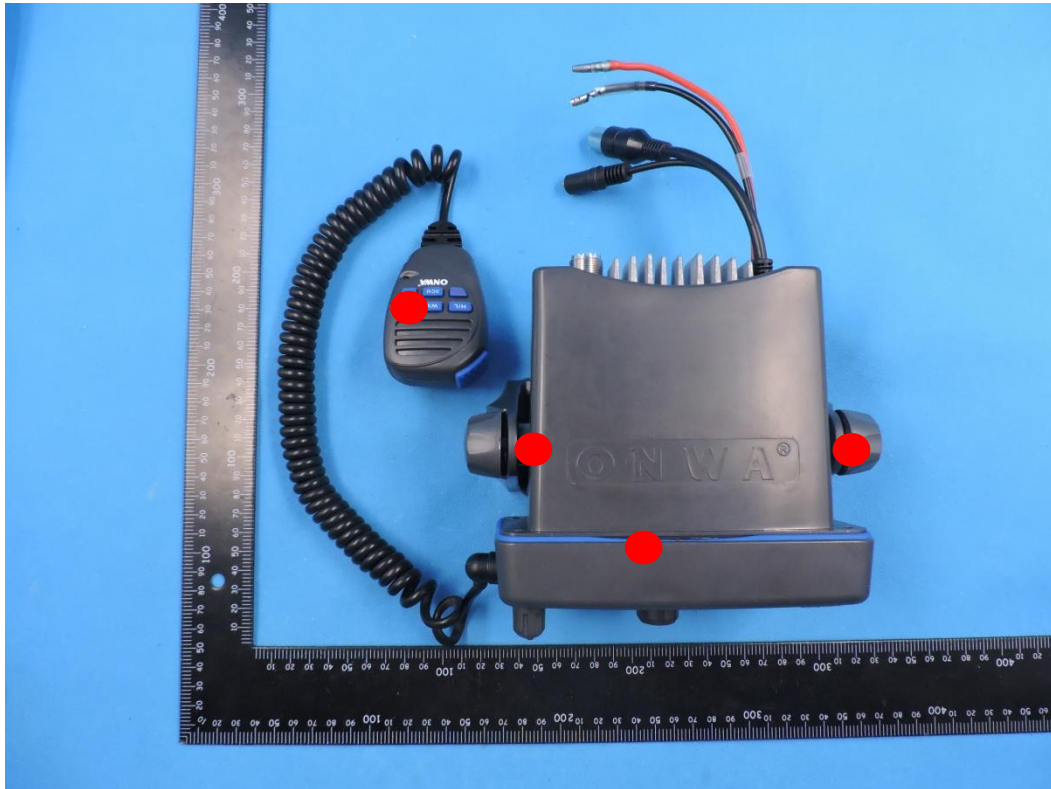
TEST RESULT

Mode	Air Discharge								Contact Discharge								Observation	Criterion	Result
Test level (kV)	2		4		8		15		2		4		6		8				
Test Location	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-			
HCP									A	A	A	A	A	A			TT,TR	B	PASS
VCP									A	A	A	A	A	A					PASS
Metal									A	A	A	A	A	A					PASS
Keying	A	A	A	A	A	A													PASS
Crevice	A	A	A	A	A	A													PASS

Note:

- 1) P/N denotes the Positive/Negative polarity of the output voltage.
- 2) Test condition:
Direct / Indirect (HCP/VCP) discharges: Minimum 50 times (Positive/Negative) at each point. Air discharges: Minimum 10 times (Positive/Negative) at each point.
- 3) N/A - denotes test is not applicable in this test report
- 4) There was not any unintentional transmission in standby mode

The Photo for Discharge Points of EUT





Red dot —Air Contact Discharged
Blue Dot —Contact Discharged



4.3 RADIATED DISTURBANCE (10.4)

4.3.1 TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-3
Required Performance	A
Frequency Range:	80 MHz - 2000 MHz
Field Strength:	10 V/m
Modulation:	400Hz Sine Wave, 80% AM Modulation
Frequency Step:	1.5×10^{-3} decades/s for the frequency range 80 MHz to 1 GHz and 0.5×10^{-3} decades/s for the frequency range 1 GHz to 2 GHz
Polarity of Antenna:	Horizontal and Vertical
Test Distance:	1 m
Antenna Height:	1.5 m

4.3.2. TEST PROCEDURE

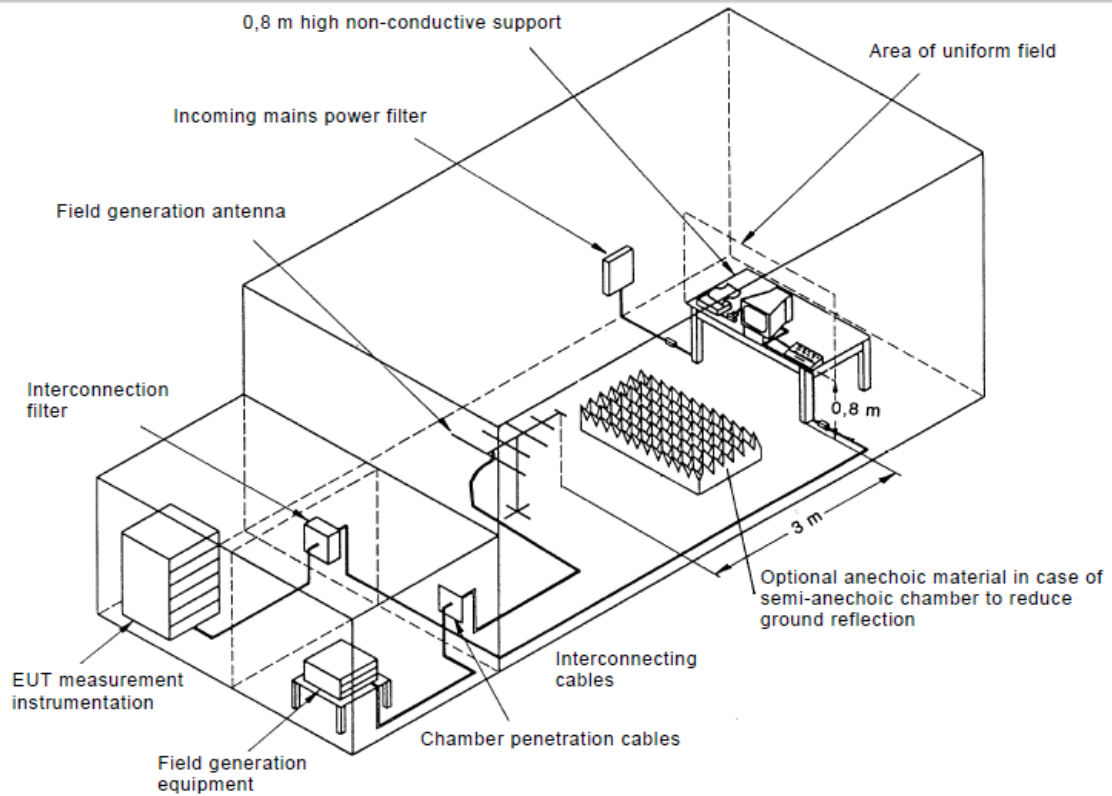
The EUT and support equipment, which are placed on a table that is 0.8 meter above ground and the testing was performed in a fully-anechoic chamber.

The testing distance from antenna to the EUT was 1 meters.

The other condition as following manner:

- The field strength level was 10V/m.
- The frequency range shall be swept at a rate in the order of 1.5×10^{-3} decades/s for the frequency range 80 MHz to 1 GHz and 0.5×10^{-3} decades/s for the frequency range 1 GHz to 2 GHz, and shall be slow enough to allow the detection of any malfunction of the EUT. Any sensitive frequencies or frequencies of dominant interest shall be discretely analyzed.
- The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.
- The test was performed with the EUT exposed to both vertically and horizontally polarized fields on each of the four sides.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.3.3 TEST SETUP



Note:

TABLE-TOP EQUIPMENT

The EUT installed in a representative system as described in section 7 of IEC/EN 61000-4-3 was placed on a non-conductive table 0.8 meters in height. The system under test was connected to the power and signal wire according to relevant installation instructions.



4.3.4 TEST RESULTS

EUT :	7" COLOR LCD FISH FINDER	Model Name :	KFish-7
Temperature :	25 °C	Relative Humidity :	54%
Pressure :	1010 hPa	Test Power :	DC 12V
Test Mode	Mode1		

TEST RESULT

Frequency Range (MHz)	RF Field Position	R.F. Field Strength	Azimuth	Observation	Perform. Criteria	Results	Judgment
80-2000	H / V	10 V/m (rms) AM Modulated 1000Hz, 80%	Front	CT,CR	A	A	PASS
			Rear				
			Left				
			Right				

Note:

- 1) P/N denotes the Positive/Negative polarity of the output voltage.
- 2) N/A - denotes test is not applicable in this test report.
- 3) There was no change operated with initial operating during the test.
- 4) There was not any unintentional transmission in standby mode



4.4 FAST TRANSIENTS (BURSTS) (10.5)

4.4.1 TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-4
Required Performance	B
Test Voltage:	Power Line : 2 kV Signal/Control Line : 1 KV
Polarity:	Positive & Negative
Impulse Frequency:	5 kHz(1kV), 2.5kHz(2kV)
Impulse Wave shape :	5/50 ns
Burst Duration:	15 ms
Burst Period:	300 ms
Test Duration:	3 min to 5 min for each of positive and negative polarity pulses

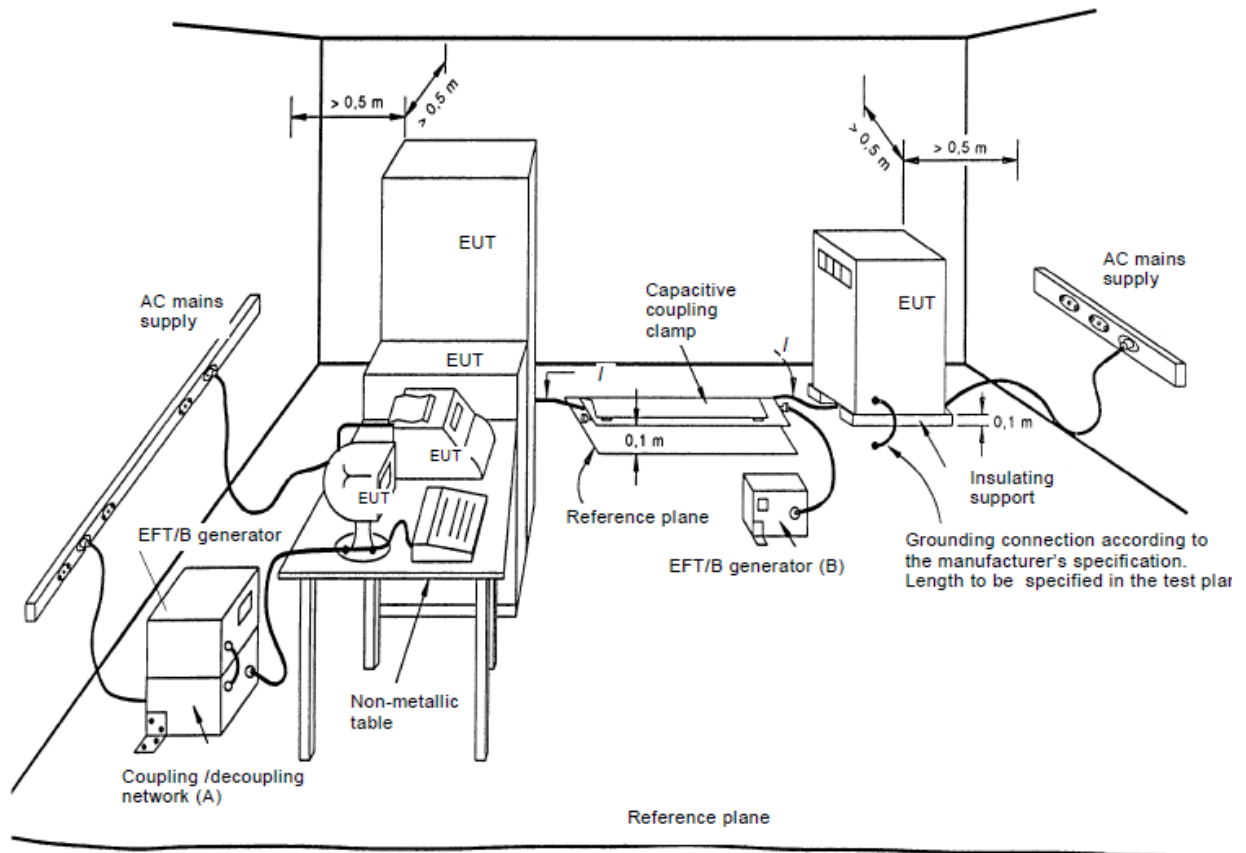
4.4.2 TEST PROCEDURE

The EUT and support equipment, are placed on a table that is 0.8 meter above a metal ground plane measured 1m*1m min. and 0.65mm thick min.

The other condition as following manner:

- The length of power cord between the coupling device and the EUT should not exceed 1 meter.
- Both positive and negative polarity discharges were applied.
- The duration time of each test sequential was 3 min to 5 min
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.4.3 TEST SETUP





4.4.4 TEST RESULTS

EUT:	7" COLOR LCD FISH FINDER	Model Name :	KFish-7
Temperature :	25 °C	Relative Humidity :	45%
Pressure :	1010 hPa	Test Power :	DC 12V
Test Mode	N/A		

Not applicable.





4.5 SLOW TRANSIENTS (SURGES)(10.6)

4.5.1 TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-5
Required Performance	B
Wave-Shape:	Combination Wave 1.2/50 us Open Circuit Voltage
Test Voltage:	Power Line : 0.5 kV, 1 kV
Impedance:	12 ohm between network and ground
Polarity:	Positive/Negative
Phase Angle:	0 /90/180/270
Pulse Repetition Rate:	1 time / min. (maximum)
Number of Tests:	5 positive and 5 negative at selected points

4.5.2 TEST PROCEDURE

a. For EUT power supply:

The surge is to be applied to the EUT power supply terminals via the capacitive coupling network. Decoupling networks are required in order to avoid possible adverse effects on equipment not under test that may be powered by the same lines, and to provide sufficient decoupling impedance to the surge wave. The power cord between the EUT and the coupling/decoupling networks shall be 2meters in length (or shorter).

b. For test applied to unshielded unsymmetrically operated interconnection lines of EUT:

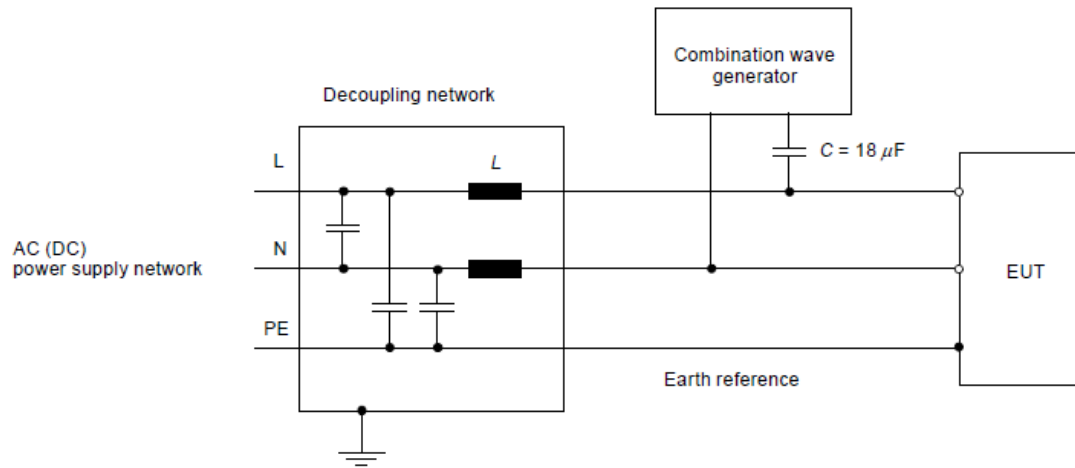
The surge is applied to the lines via the capacitive coupling. The coupling /decoupling networks shall not influence the specified functional conditions of the EUT. The interconnection line between the EUT and the coupling/decoupling networks shall be 2 meters in length (or shorter).

c. For test applied to unshielded symmetrically operated interconnection /telecommunication lines of EUT:

The surge is applied to the lines via gas arrestors coupling. Test levels below the ignition point of the coupling arrestor cannot be specified. The interconnection line between the EUT and the coupling/decoupling networks shall be 2 meters in length (or shorter).

d. For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.5.3 TEST SETUP





4.5.4 TEST RESULTS

EUT :	7" COLOR LCD FISH FINDER	Model Name :	KFish-7
Temperature :	25 °C	Relative Humidity :	45%
Pressure :	1010 hPa	Test Power :	DC 12V
Test Mode	N/A		

Not applicable.





4.6 CONDUCTED RADIO FREQUENCY DISTURBANCE (10.3)

4.6.1 TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-6
Required Performance	A
Frequency Range:	0.15 MHz - 80 MHz
Field Strength:	3 V r.m.s. amplitude swept over the frequency range 150 kHz to 80 MHz 10 V r.m.s. amplitude at spot frequencies: 2 MHz, 3 MHz, 4 MHz, 6.2 MHz, 8.2 MHz, 12.6 MHz, 16.5 MHz, 18.8 MHz, 22 MHz and 25 MHz.
Modulation:	400Hz Sine Wave, 80%, AM Modulation
Frequency Step:	1 % of fundamental
Dwell Time:	at least 3 seconds

4.6.2 TEST PROCEDURE

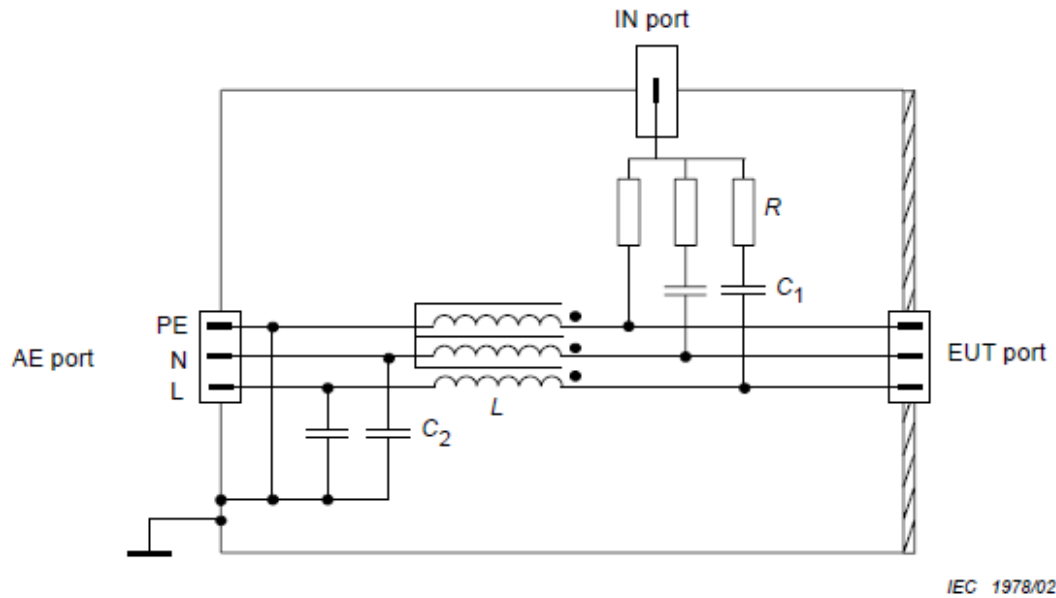
The EUT and support equipment, are placed on a table that is 0.1 meter above a metal ground plane measured 1m*1m min. and 0.65 mm thick min.

During the test, the uplink speech output level was monitored, it was confirmed to be at least 35 Db less than the previously- recorded reference level.

The other condition as following manner:

- a. The field strength level was 3V.
The frequency range is swept from 150 KHz to 80 MHz, with the signal 80%amplitude modulated with a 1kHz sine wave, 10 V r.m.s. amplitude at spot frequencies: 2 MHz, 3 MHz, 4 MHz, 6,2 MHz, 8,2 MHz, 12,6 MHz, 16,5 MHz, 18,8 MHz, 22 MHz and 25 MHz. The rate of sweep did not exceed 1.5×10^{-3} decade/s. Where the frequency range is swept incrementally, the step size was 1% of fundamental.
- c. The dwell time at each frequency shall be not less than the time necessary for the EUT to be able to respond.
- d. For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.6.3 TEST SETUP



For the actual test configuration, please refer to the related Item –EUT Test Photos.

NOTE:

CDN-M3, C_1 (typ) = 10 nF, C_2 (typ) = 47 nF, $R = 300 \Omega$, $L \geq 280 \mu\text{H}$ at 150 kHz.

CDN-M2, C_1 (typ) = 10 nF, C_2 (typ) = 47 nF, $R = 200 \Omega$, $L \geq 280 \mu\text{H}$ at 150 kHz.

CDN-M1, C_1 (typ) = 22 nF, C_2 (typ) = 47 nF, $R = 100 \Omega$, $L \geq 280 \mu\text{H}$ at 150 kHz.



4.6.4 TEST RESULTS

EUT :	7" COLOR LCD FISH FINDER	Model Name :	KFish-7
Temperature :	22.5 °C	Relative Humidity :	50%
Pressure :	1010 hPa	Test Power :	DC 12V
Test Mode	Mode1		

Test Ports (Mode)	Freq. Range (MHz)	Field Strength	Observation	Perform. Criteria	Results	Judgment
Input/ Output AC. Power Port	0.15 ---80	3 V r.m.s. amplitude swept over the frequency range 150 kHz to 80 MHz 10 V r.m.s. amplitude at spot frequencies: 2 MHz, 3 MHz, 4 MHz, 6.2 MHz, 8.2 MHz, 12.6 MHz, 16.5 MHz, 18.8 MHz, 22 MHz and 25 MHz. AM Modulated 400Hz, 80%	N/A	N/A	N/A	N/A
Input/ Output DC. Power Port	0.15 --- 80		CT, CR	A	A	PASS
Signal Line	0.15 --- 80		CT, CR	A	A	PASS

Note: "A" stand for, during test, operate as intended no loss of function, no degradation of performance, no unintentional transmissions and after test, no degradation of performance, no loss of function, no loss of stored data or user programmable functions.

4.7 POWER SUPPLY SHORT TERM VARIATION (10.7)

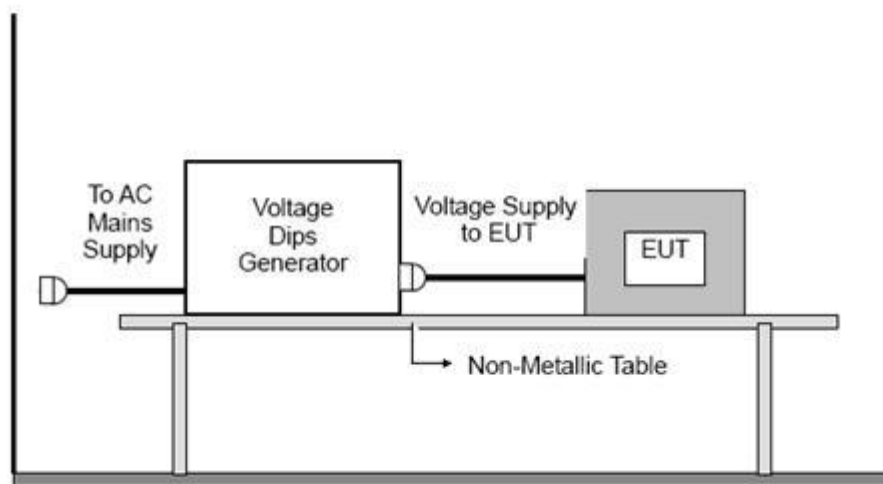
4.7.1 TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-11
Voltage Interruptions:	voltage: nominal $\pm (20 \pm 1) \%$, duration $1,5 \text{ s} \pm 0,2 \text{ s}$, frequency: nominal $\pm (10 \pm 0,5) \%$, duration $5 \text{ s} \pm 0,5 \text{ s}$, superimposed;
Test Duration Time:	10min

4.7.2 TEST PROCEDURE

The EUT shall be tested for each selected combination of test levels and duration with a sequence of three dips/interruptions with intervals of 10 min. Each representative mode of operation shall be tested. Abrupt changes in supply voltage shall occur at zero crossings of the voltage waveform.

4.7.3 TEST SETUP



For the actual test configuration, please refer to the related Item –EUT Test Photos.



4.7.4 TEST RESULTS

EUT :	7" COLOR LCD FISH FINDER	Model Name :	KFish-7
Temperature :	25 °C	Relative Humidity :	45%
Pressure :	1010 hPa	Test Power :	DC 12V
Test Mode	N/A		

Not applicable.



4.8 POWER SUPPLY FAILURE (10.8)

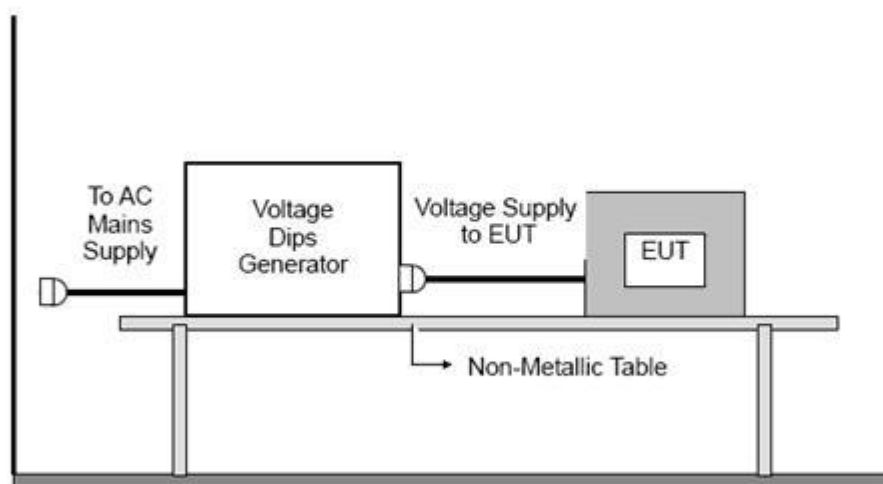
4.8.1 TEST SPECIFICATION

Basic Standard:	IEC/EN 61000-4-11
Voltage Interruptions:	100% reduction, 250 Cycles
Test Duration Time:	Minimum three test events in sequence
Interval between Event:	Minimum 60 seconds
Test Cycle:	3 times

4.8.2 TEST PROCEDURE

The EUT shall be tested for each selected combination of test levels and duration with a sequence of three dips/interruptions with intervals of 10 s minimum (between each test event). Each representative mode of operation shall be tested. Abrupt changes in supply voltage shall occur at zero crossings of the voltage waveform.

4.8.3 TEST SETUP



For the actual test configuration, please refer to the related Item –EUT Test Photos.



4.8.4 TEST RESULTS

EUT :	7" COLOR LCD FISH FINDER	Model Name :	KFish-7
Temperature :	25 °C	Relative Humidity :	45%
Pressure :	1010 hPa	Test Power :	DC 12V
Test Mode	N/A		

Not applicable.





5. DURABILITY AND RESISTANCE TO ENVIRONMENTAL CONDITIONS – METHODS OF TESTING AND REQUIRED TEST RESULTS

5.1 DRY HEAT

5.1.1 PURPOSE

To simulate the effects of temperature stress on equipment in the non-operating (un-powered) mode. A temperature of +70 °C is the maximum likely to be encountered in enclosed spaces on ships and in equipment exposed to the full effects of solar radiation in ports.

5.1.2 METHOD OF TEST

The EUT shall be placed in a chamber at normal room temperature and relative humidity.

The temperature shall then be raised to and maintained at +70 °C $\pm$ 3 °C, for a period of 10 h to 16 h.

At the end of the test, the EUT shall be returned to normal environmental conditions and then subjected to a performance check as specified in the relevant equipment standard.

5.1.3 TEST RESULT

The requirements of the performance check shall be met.





5.2 FUNCTIONAL TEST (PORTABLE, PROTECTED AND EXPOSED EQUIPMENT)

5.2.1 PURPOSE

This test determines the ability of equipment to be operated at high ambient temperatures and to operate through temperature changes. The reasonable maximum air temperature likely to be encountered over the sea is +32 °C and the maximum solar gain at sea is +23 °C giving +55 °C as the maximum temperature likely to be encountered by ships at sea.

5.2.2 METHOD OF TEST

The EUT shall be placed in a chamber at normal room temperature and relative humidity. The EUT and, if appropriate, any climatic control devices with which it is provided shall then be switched on. The temperature shall then be raised to and maintained at +55 °C ± 3 °C.

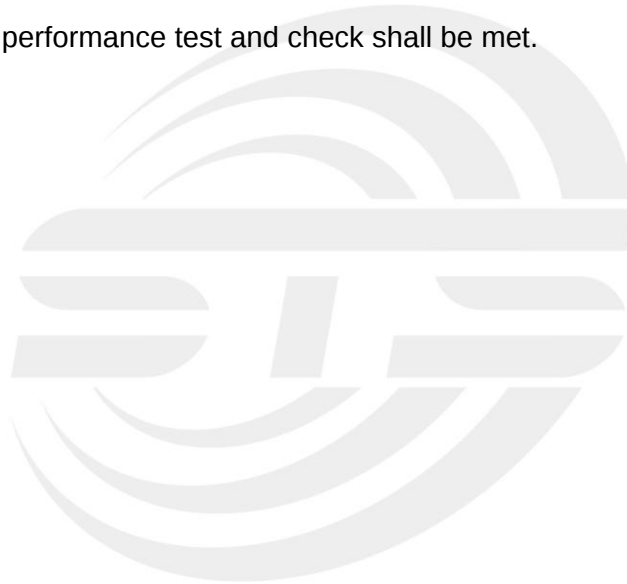
At the end of a soak period of 10 h to 16 h at +55 °C ± 3 °C, the EUT shall be subjected to a performance test and check as specified in the relevant equipment standard (see 7.1).

The temperature of the chamber shall be maintained at +55 °C ± 3 °C during the whole performance test period.

At the end of the test, the EUT shall be returned to normal environmental conditions.

5.2.3 TEST RESULT

The requirements of the performance test and check shall be met.





5.3 DAMP HEAT

5.3.1 PURPOSE

This test determines the ability of equipment to be operated under conditions of high humidity. A single cycle is used with an upper temperature limit of +40 °C which is the maximum that occurs in the earth's surface atmosphere with a relative humidity of 95 %.

5.3.2 METHOD OF TEST

The EUT shall be placed in a chamber at normal room temperature and relative humidity. The temperature shall then be raised to +40 °C $\pm$ 2 °C, and the relative humidity raised to 93 % $\pm$ 3 % over a period of 3 h $\pm$ 0,5 h. These conditions shall be maintained for a period of 10 h to 16 h. Any climatic control devices provided in the EUT may be switched on at the conclusion of this period.

The EUT shall be switched on 30 min later, or after such period as agreed by the manufacturer, and shall be kept operational for at least 2 h during which period the EUT shall be subjected to a performance check as specified in the relevant equipment standard.

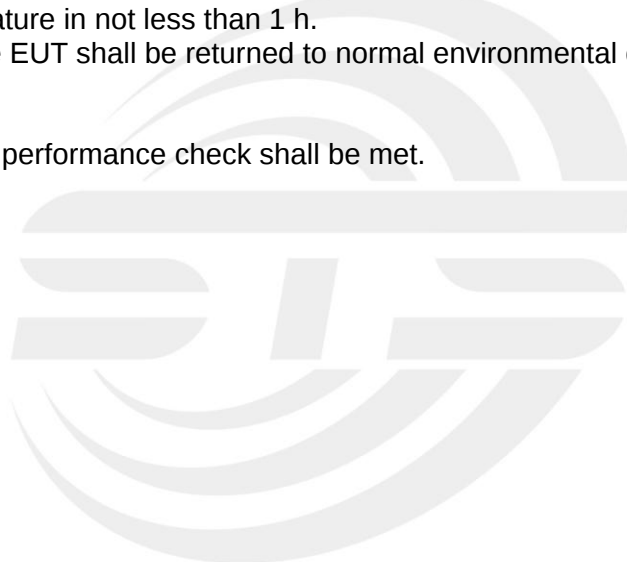
The temperature and relative humidity of the chamber shall be maintained as specified during the whole test period.

At the end of the test period and with the EUT still in the chamber, the chamber shall be brought to room temperature in not less than 1 h.

At the end of the test the EUT shall be returned to normal environmental conditions.

5.3.3 TEST RESULT

The requirements of the performance check shall be met.





5.4 LOW TEMPERATURE

5.4.1 PURPOSE

Storage test (portable equipment)

This test simulates the effects of temperature stress on equipment in the non-operating (un-powered) mode. It is applied to the portable equipment because of the importance that emergency equipment functions correctly after prolonged non-operation.

Functional tests

These tests determine the ability of equipment to be operated at low temperatures and also to demonstrate the ability of equipment to start up at low ambient temperatures.

5.4.1.2 METHOD OF TEST

Storage test (portable equipment)

The EUT shall be placed in a chamber at normal room temperature and relative humidity.

The temperature shall then be lowered to and maintained at $-30\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, for a period of 10 h to 16 h.

At the end of the test period, the EUT shall be returned to normal environmental conditions and then subjected to a performance check as specified in the relevant equipment standard.

Functional tests

The EUT shall be placed in a chamber at normal room temperature and relative humidity. The temperature shall then be reduced to, and maintained at $-20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, for a period of 10 h to 16 h. Any climatic control devices provided in the EUT may be switched on at the conclusion of this period.

The EUT shall be switched on 30 min later, or after such period as agreed by the manufacturer, and shall be kept operational for at least 2 h during which period the EUT shall be subjected to a performance check test and check as specified in the relevant equipment standard.

The temperature of the chamber shall be maintained at $-20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ during the whole test period. At the end of the test the EUT shall be returned to normal environmental conditions.

EXPOSED EQUIPMENT

The EUT shall be subject to the conditions specified for portable equipment except that the temperature of the chamber shall be reduced to, and maintained at $-25\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

5.4.1.3 TEST RESULT

The requirements of the performance check shall be met.



5.5 THERMAL SHOCK (PORTABLE EQUIPMENT)

5.5.1 PURPOSE

To determine the ability of portable equipment to function correctly after sudden immersion in water from storage at high temperature.

5.5.2 METHOD OF TEST

The EUT shall be placed in an atmosphere of $+70\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ for 1 h. It shall then be immersed in water at $+25\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ to a depth of $100\text{ mm} \pm 5\text{ mm}$, measured from the highest point of the EUT to the surface of the water, for a period of 1 h.

At the end of the test the EUT shall be subjected to a performance check, and shall then be examined for damage and for unwanted ingress of water. Following examination, the EUT shall be resealed in accordance with the manufacturer's instructions. Alternatively, if there are no external signs of unwanted ingress of water, an internal examination of the EUT, which involves disturbance to seals, may be carried out after all environmental tests have been completed.

5.5.3 REQUIRED RESULT

The requirements of the performance check shall be met. There shall be no damage to the EUT or ingress of water. The findings shall be noted in the test report.





5.6 DROP (PORTABLE EQUIPMENT)

5.6.1 PURPOSE

Drop on hard surface

This test simulates the effects of a free fall of an equipment onto the deck of a ship resulting from mishandling. It is applicable only to portable VHF radios, that are most likely to suffer mishandling.

Drop into water

This test simulates the effects of a free fall of an equipment into the sea from the deck of a ship 20 m above. It is applicable only to portable equipment, which has an operational requirement to be deployed in this way. It is not applicable to portable VHF radios, as there is no requirement for this equipment to float.

5.6.2 METHOD OF TEST

Drop on hard surface

The test surface shall consist of a piece of solid hard wood with a thickness of at least 150 mm and a mass of 30 kg or more.

The height of the lowest part of the EUT relative to the test surface at the moment of release shall be 1000 mm $\pm$ 10 mm.

The EUT shall be subjected to this test configured for use as in operational circumstances. At the end of the test the EUT shall be subjected to a performance check, and shall then be examined for external indications of damage.

Drop into water

A series of three drops shall be carried out. Each drop shall be performed with the initial position of the EUT different from the preceding one. The height of the lowest part of the EUT under test relative to the water surface at the moment of release shall be 20 m $\pm$ 1 m.

At the end of the test the EUT shall be subjected to a performance check, and shall then be examined for damage and for unwanted ingress of water. Following examination, the EUT shall be resealed in accordance with the manufacturer's instructions. Alternatively, if there are no external signs of unwanted ingress of water, an internal examination which involves disturbance to seals may be carried out after all environmental tests have been completed.

5.6.3 TEST RESULT

EUT no visible external indications of damage that could affect the functionality of the EUT. And no damage to the EUT or ingress of water



5.7 VIBRATION (ALL EQUIPMENT CATEGORIES)

5.7.1 PURPOSE

This test determines the ability of equipment to withstand vibration without resulting in mechanical weakness or degradation in performance. The test simulates the effect of vibration induced in a ship's hull by its propeller and machinery. This is generally at frequencies of up to 13 Hz and predominantly vertical. The tests at higher frequencies simulate the effect of slamming which occurs in irregular stormy seas, and is predominantly horizontal. The test does not simulate the effect of regular seas giving the translational components of surging, swaying and heaving, and the corresponding rotational components of rolling, pitching and yawing which generally produce accelerations too small to be of consequence to electronic equipment.

5.7.2 METHOD OF TEST

The EUT, complete with any shock and vibration absorbers with which it is provided, shall be fastened to the vibration table by its normal means of support and in its normal attitude. The EUT may be resiliently suspended to compensate for weight not capable of being withstood by the vibration table. Provision may be made to reduce or nullify any adverse effect on EUT performance which might be caused by the presence of an electromagnetic field due to the vibration unit.

The EUT shall be subjected to sinusoidal vertical vibration at all frequencies between:

- 2 Hz to 5 Hz and up to 13.2 Hz with an excursion of $\pm 1 \text{ mm} \pm 10 \%$ (7 m/s² maximum acceleration at 13.2 Hz);
- above 13.2 Hz and up to 100 Hz with a constant maximum acceleration of 7 m/s².

The frequency sweep rate shall be 0.5 octaves/min in order to allow the detection of resonances in any part of the EUT as mounted.

A resonance search shall be carried out throughout the test. During the resonance search the EUT shall be externally observed, by unaided visual and aural means, for obvious signs of any resonances of components or sub-assemblies, that may affect the integrity of the EUT. Such observations shall be recorded in the test report. If any resonance, as measured by a sensor fixed to the outside of the EUT at the location where obvious signs of resonance have been observed, has a magnitude ratio ≥ 5 measured relative to the surface where the EUT is fastened, the EUT shall be subjected to a vibration endurance test at each resonant frequency at the vibration level specified in the test with a duration of 2 h. When resonant frequencies with magnitude ratios ≥ 5 are harmonically related, only the fundamental frequency shall be tested. If no resonance with a magnitude ratio ≥ 5 occurs, the endurance test shall be carried out at one single observed frequency. If no resonance occurred, the endurance test shall be carried out at a frequency of 30 Hz.

Performance check(s) shall be carried out at least once during each endurance test period, and once before the end of each endurance test period.

The procedure shall be repeated with vibration in each of two mutually perpendicular directions in the horizontal plane.

5.7.3 TEST RESULT

EUT met the performance check.



5.8 RAIN AND SPRAY (EXPOSED EQUIPMENT)

5.8.1 PURPOSE

This test simulates the effects of rain, sea spray and light breaking seas on equipment. It is applicable to exposed equipment mounted above deck level such as antennas. It is not applicable to portable equipment, as these are required to meet a more stringent immersion test.

5.8.2 METHOD OF TEST

The test shall be carried out by spraying the EUT from all practicable directions with a stream of water from a standard test nozzle (hose) as shown in figure 6 of IEC 60529. The EUT shall operate throughout the test.

The conditions to be observed are as follows:

- internal diameter of nozzle: 12.5 mm;
- delivery rate: 100 l/min $\pm$ 5 % ;
- water pressure: to be adjusted to achieve the specified delivery rate;
- core of substantial stream: circle of approximately 120 mm diameter at distance 2,5 m from nozzle;
- test duration: approximately 30 min;
- distance from nozzle to the equipment surface: approximately 3 m.

At the end of the test the EUT shall be subjected to a performance check, and shall then be examined for damage and for unwanted ingress of water. Following examination, the EUT shall be resealed in accordance with the manufacturer's instructions.

Alternatively, if there are no external signs of unwanted ingress of water, an internal examination which involves disturbance to seals may be carried out after all environmental tests have been completed.

5.8.3 TEST RESULT

EUT met the performance check and no visible external indications of damage or of unwanted ingress of water.



5.9 IMMERSION

5.9.1 PURPOSE

Submerged equipment

This test simulates the effects of water pressure on equipment intended to be mounted permanently under water.

Portable equipment

To simulate the effects of water pressure on equipment which may be required to float free from a sinking ship.

Portable equipment (temporary immersion)

This test simulates the effects of water pressure on VHF portable radio equipment which although not designed to float may experience a temporary immersion whilst attached to a survivor.

5.9.2 METHOD OF TEST

Submerged equipment

A hydraulic pressure of 600 kPa (6 bar) shall be applied for a period of 12 h to that part of the EUT that is normally in contact with the water. The remainder of the EUT shall be exposed to the atmosphere.

At the end of the test, the EUT shall be subjected to a performance check, and shall then be examined for damage and for unwanted ingress of water. Following examination, the EUT shall be resealed in accordance with the manufacturer's instructions. Alternatively, if there are no external signs of unwanted ingress of water, an internal examination which involves disturbance to seals may be carried out after all environmental tests have been completed.

Portable equipment

A hydraulic pressure of 100 kPa (1 bar) shall be applied to the EUT for a period of 5 min. At the end of the test the EUT shall be subjected to a performance check, and shall then be examined for damage and for unwanted ingress of water. Following examination, the EUT shall be resealed in accordance with the manufacturer's instructions. Alternatively, if there are no external signs of unwanted ingress of water, an internal examination which involves disturbance to seals may be carried out after all environmental tests have been completed.

Portable equipment (temporary immersion)

The test shall be carried out by completely immersing the EUT in water so that the following conditions are satisfied:

- the highest point of the EUT is located 1 m below the surface of the water;
- the duration of the test is 5 min;
- the water temperature does not differ from that of the equipment by more than 5 K.

At the end of the test the EUT shall be subjected to a performance check, and shall then be examined for damage and for unwanted ingress of water. Following examination, the EUT shall be resealed in accordance with the manufacturer's instructions. Alternatively, if there are no external signs of unwanted ingress of water, an internal examination which involves disturbance to seals may be carried out after all environmental tests have been completed.

5.9.3 TEST RESULT

EUT met the performance check and no visible external indications of damage or of unwanted ingress of water.



5.10 SOLAR RADIATION (PORTABLE EQUIPMENT)

5.10.1 PURPOSE

This test simulates the effects of continuous solar radiation on equipment which are intended to be mounted above deck levels and exposed to the weather.

5.10.2 METHOD OF TEST

The EUT shall be placed on a suitable support and exposed continuously to a simulated solar radiation source as specified in table 4 for 80 h. The intensity at the test point, which shall also include any radiation reflected from the test enclosure, shall be $1120 \text{ W/m}^2 \pm 10\%$ with a spectral distribution as given in table 4.

At the end of the test, the EUT shall be subjected to a performance check and an examination with the naked eye.

Table 4 – Spectral energy distribution and permitted tolerances

Spectral Region	Ultraviolet B*	Ultraviolet A	Visible			Infrared
Bandwidth μm	0.28 – 0.32	0.32 – 0.40	0.40 – 0.52	0.52 – 0.64	0.64 – 0.78	0.78 – 3.00
Irradiation W/m^2	5	63	200	186	174	492
Tolerance %	± 35	± 25	± 10	± 10	± 10	± 20

* Radiation shorter than $0.30 \mu\text{m}$ reaching the earth's surface is insignificant.

5.10.3 TEST RESULT

EUT met the performance check and no signs of harmful deterioration of the equipment, including label.



5.11 OIL RESISTANCE (PORTABLE EQUIPMENT)

5.11.1 PURPOSE

This test simulates the effects of mineral oil on equipment.

5.11.2 METHOD OF TEST

The EUT shall be immersed at a temperature of $19\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 3 h in a mineral oil of the following specification:

- aniline point: $120\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$;
- flashpoint: minimum $240\text{ }^{\circ}\text{C}$;
- viscosity: (10 – 25) cST at $99\text{ }^{\circ}\text{C}$.

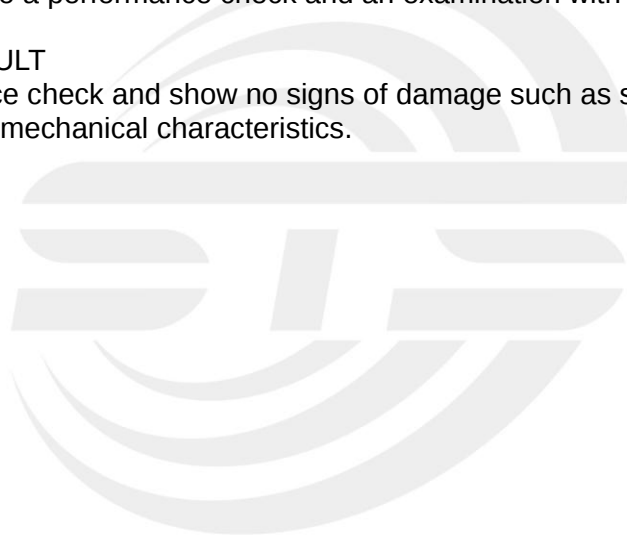
The following oils may be used:

- ASTM oil No. 1;
- ASTM oil No. 5;
- ISO oil No. 1.

After the test, the EUT shall be cleaned in accordance with the manufacturer's instructions. The EUT shall then be subjected to a performance check and an examination with the naked eye.

5.11.3 REQUIRED RESULT

EUT met the performance check and show no signs of damage such as shrinking, cracking, swelling, dissolution or change of mechanical characteristics.





5.12 CORROSION (SALT MIST) (ALL EQUIPMENT CATEGORIES)

5.12.1 PURPOSE

This test determines the ability of an equipment to be exposed to a salt laden atmosphere without physical degradation. The cyclic nature of the test produces an acceleration of effects compared with service conditions.

5.12.2 METHOD OF TEST

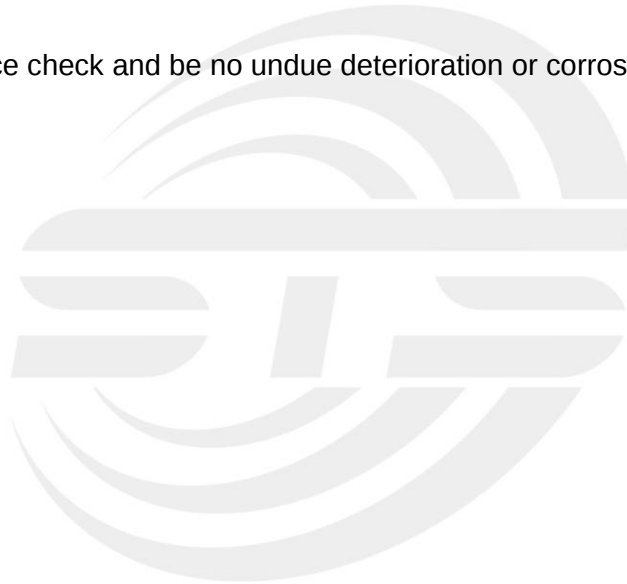
The EUT shall be placed in a chamber and sprayed with a salt solution for 2 h at normal temperature. The salt solution shall be prepared by dissolving (5 ± 1) parts by weight of sodium chloride (NaCl) in 95 parts by weight of distilled or demineralized water.

At the end of the spraying period, the EUT shall be placed in a chamber which shall be maintained at a temperature of $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, and a relative humidity between 90 % and 95 % for a period of seven days. The EUT shall be subjected to a test comprising four spraying periods, each of duration 2 h, with a storage period of seven days after each.

At the conclusion of the test the EUT shall be inspected with the naked eye without magnification. The EUT shall then be subjected to a performance check.

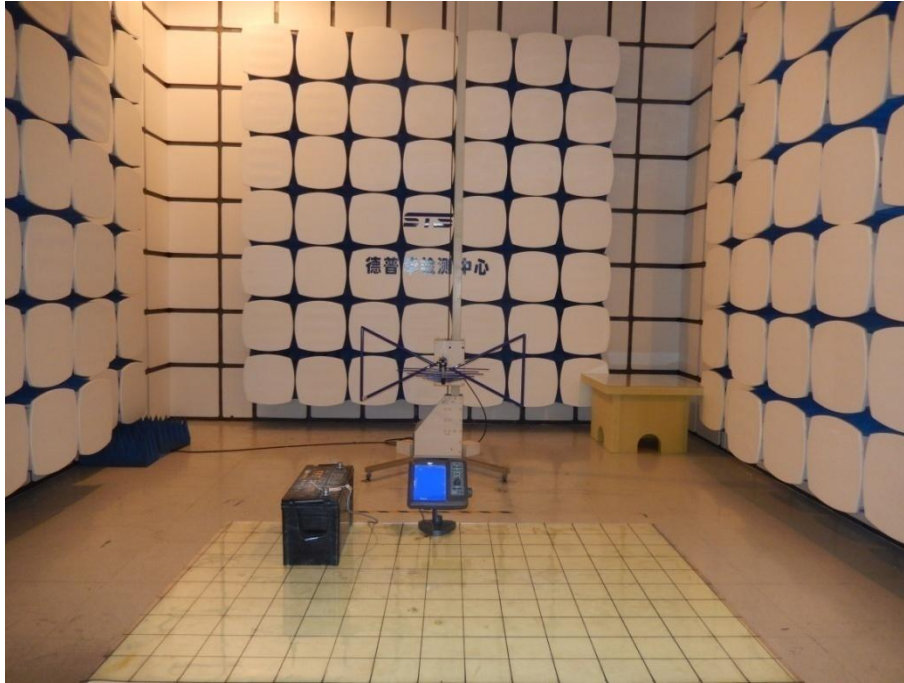
5.12.3 TEST RESULT

EUT met the performance check and be no undue deterioration or corrosion of metal parts.



APPENDIX I-PHOTOGRAPHS OF EUT

RE



ESD



CS



RS



APPENDIX II-PHOTOGRAPHS OF EUT CONSTRUCTIONAL DETAILS

Photo 1



Photo 2

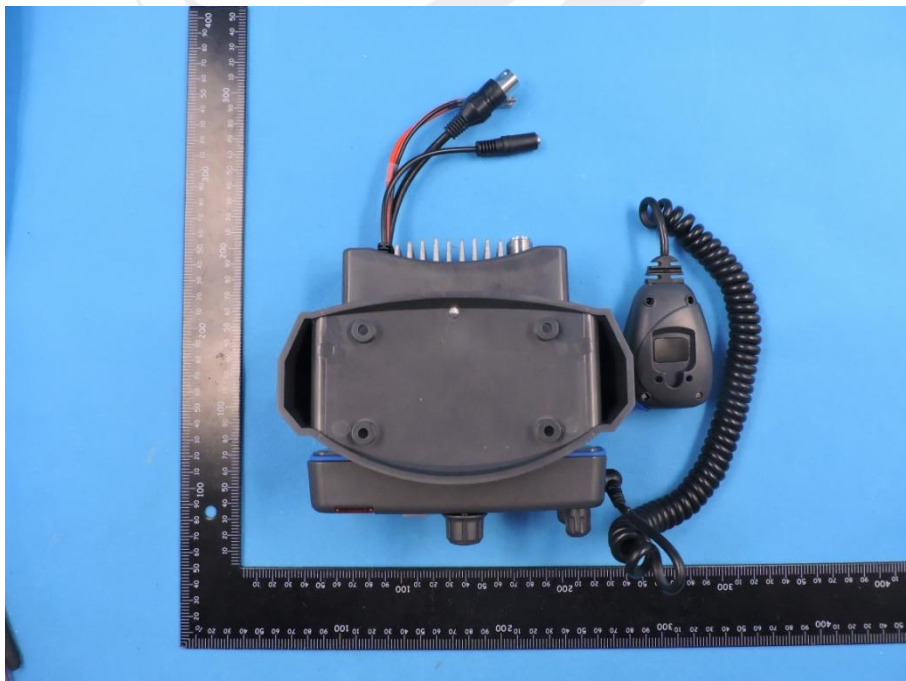


Photo 3

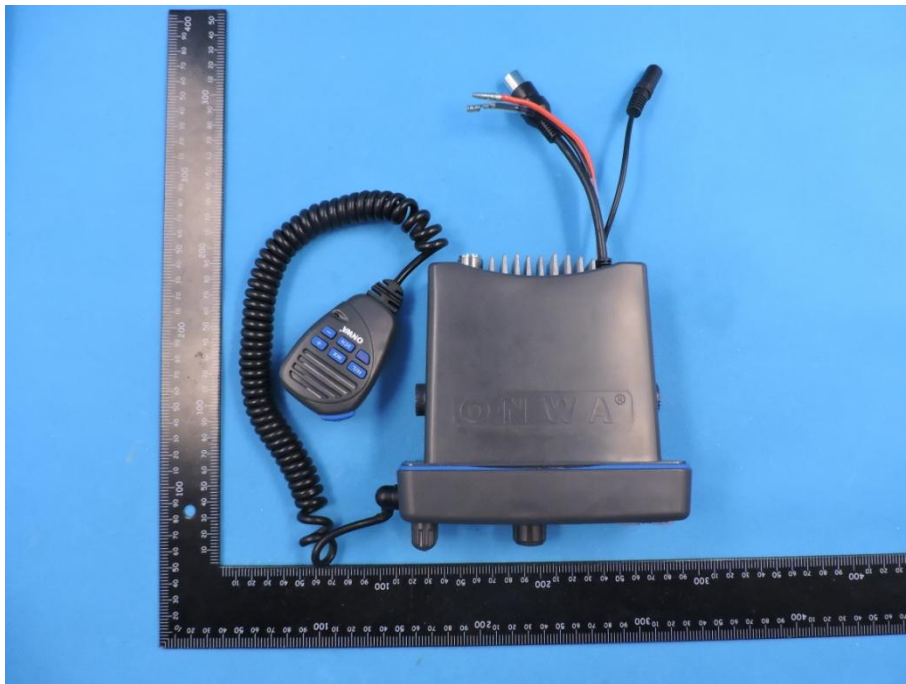


Photo 4

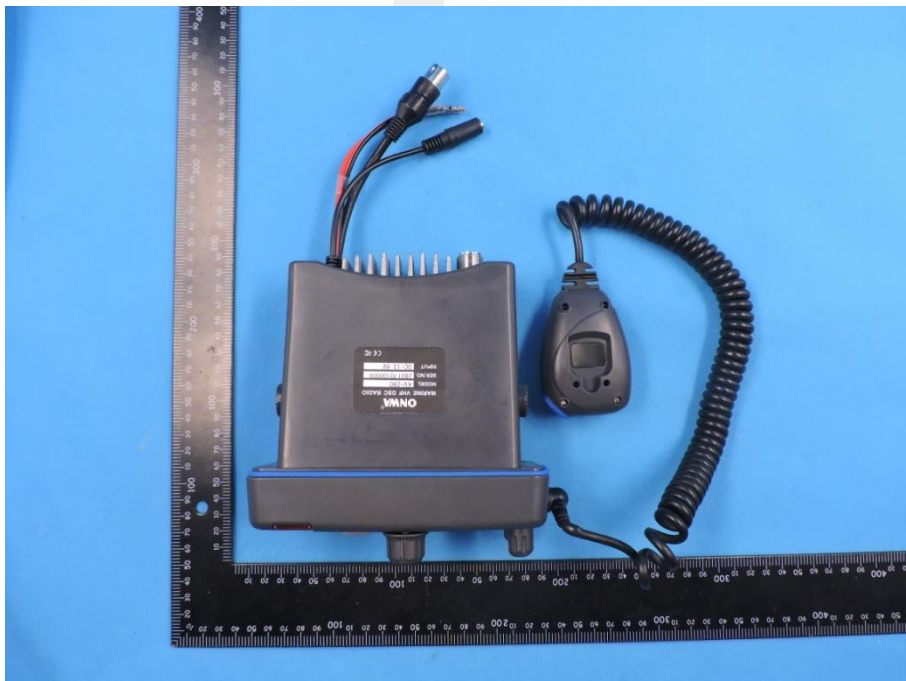


Photo 5



Photo 6



Photo 7

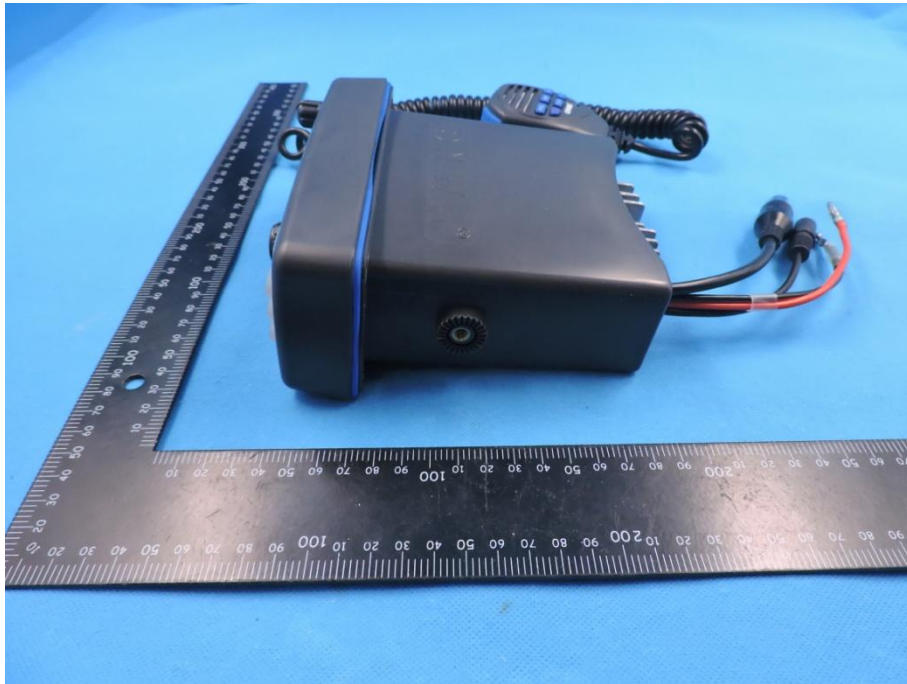


Photo 8



Photo 9

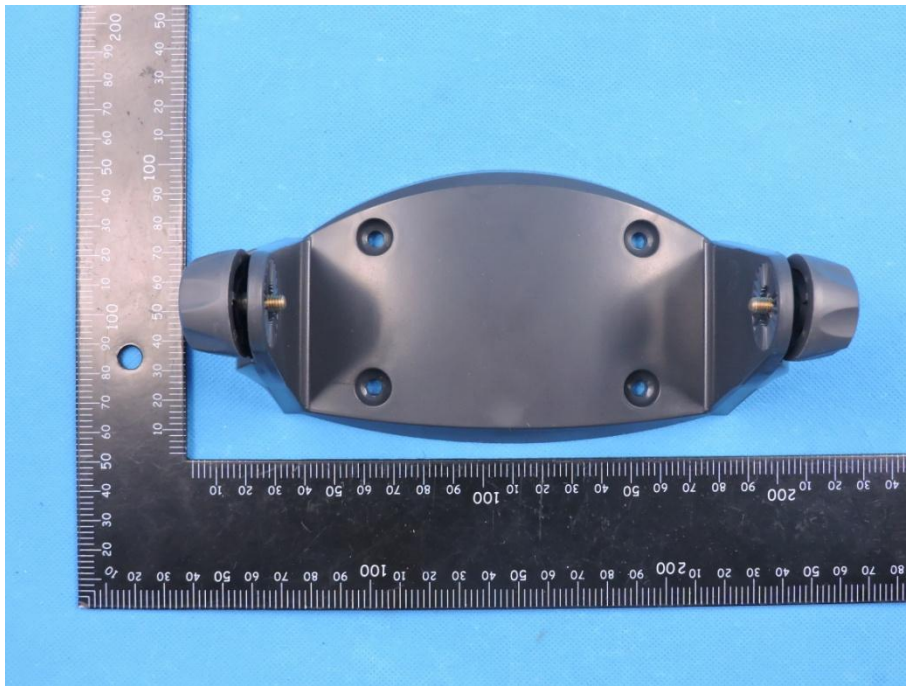


Photo 10

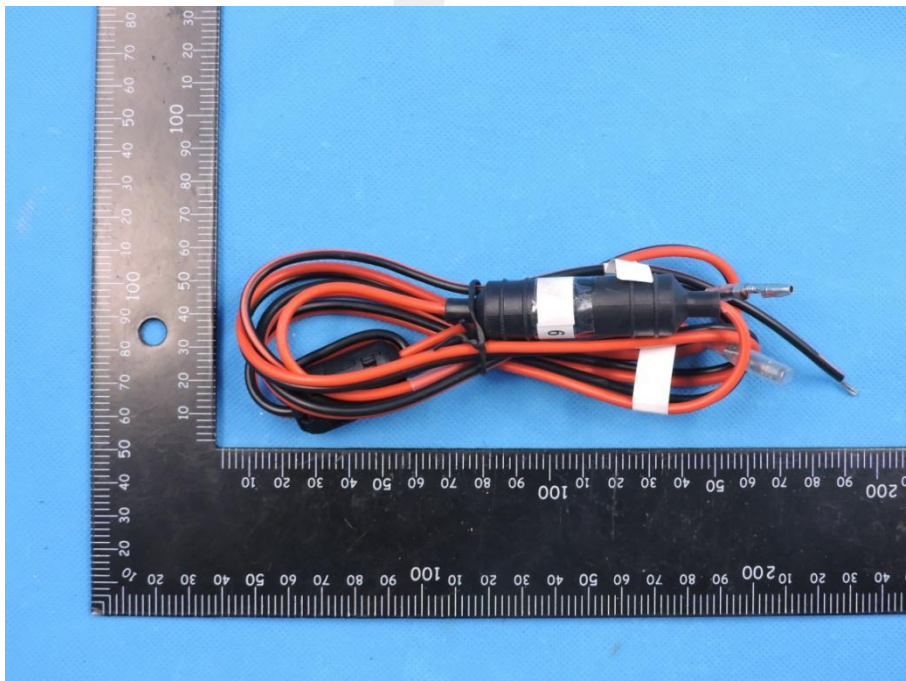


Photo 11

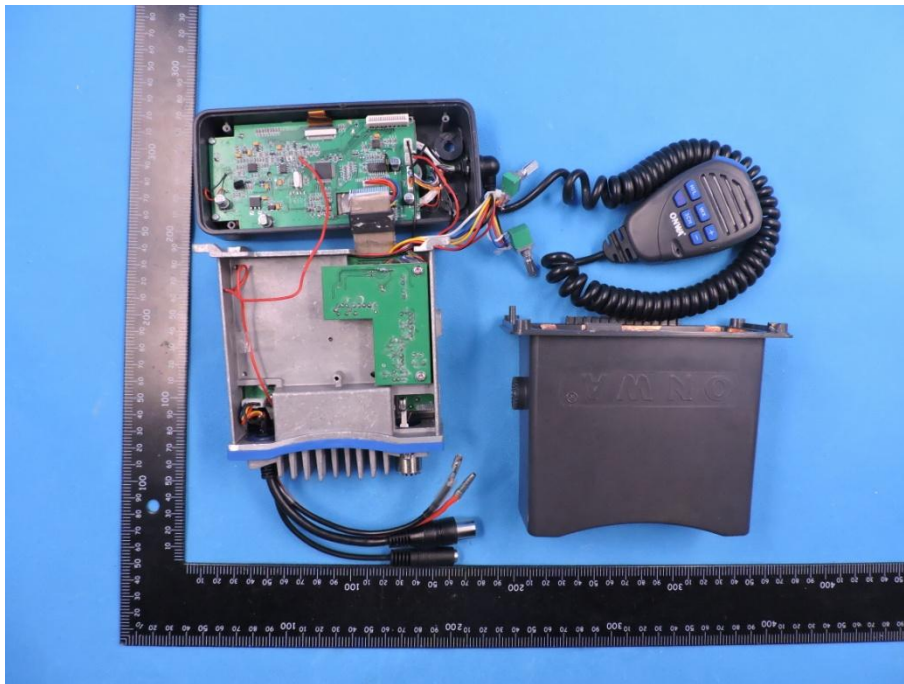


Photo 12

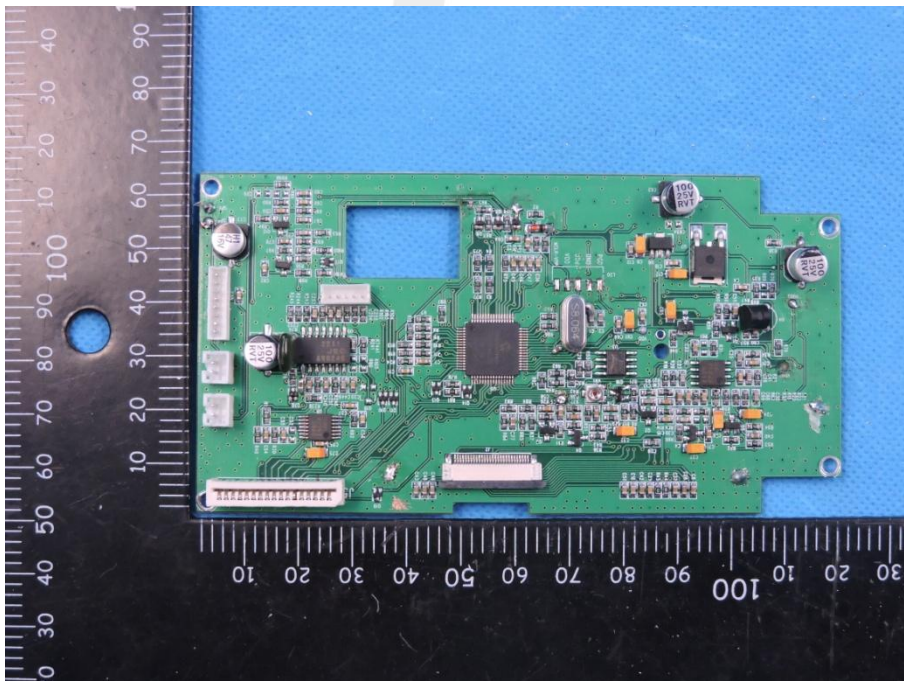


Photo 13

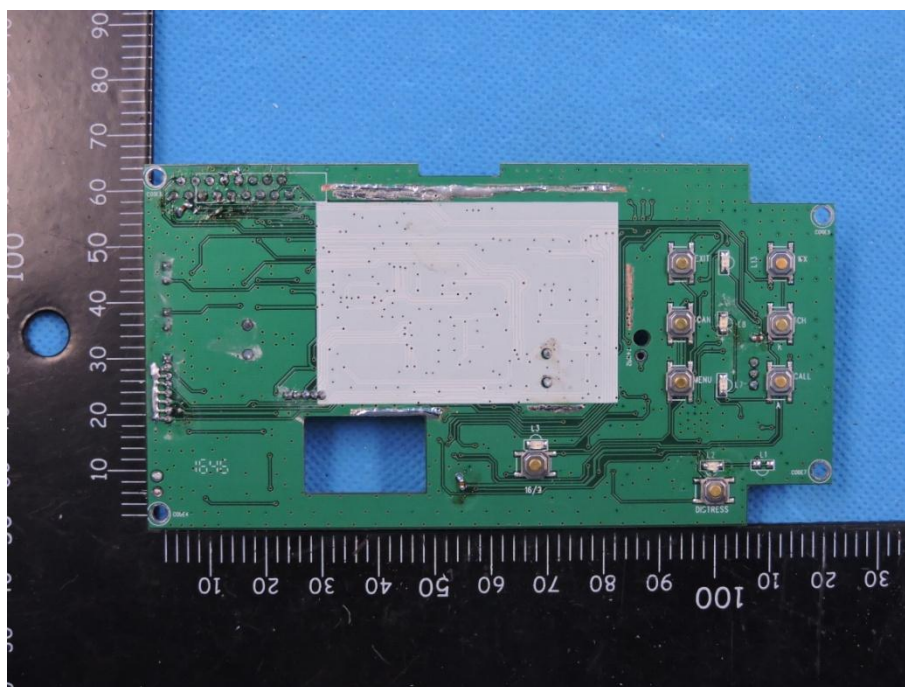


Photo 14

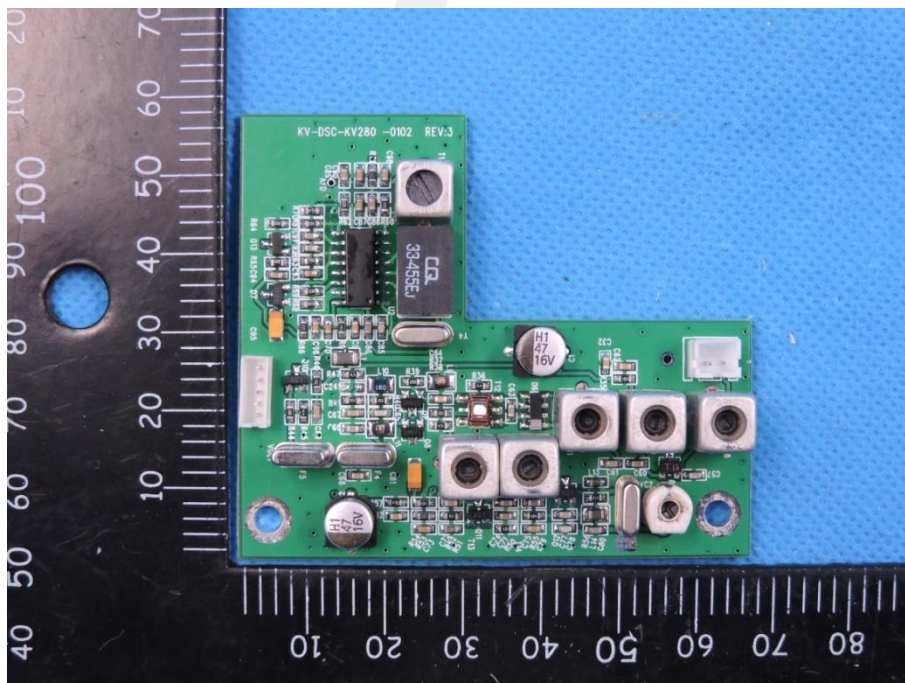


Photo 15

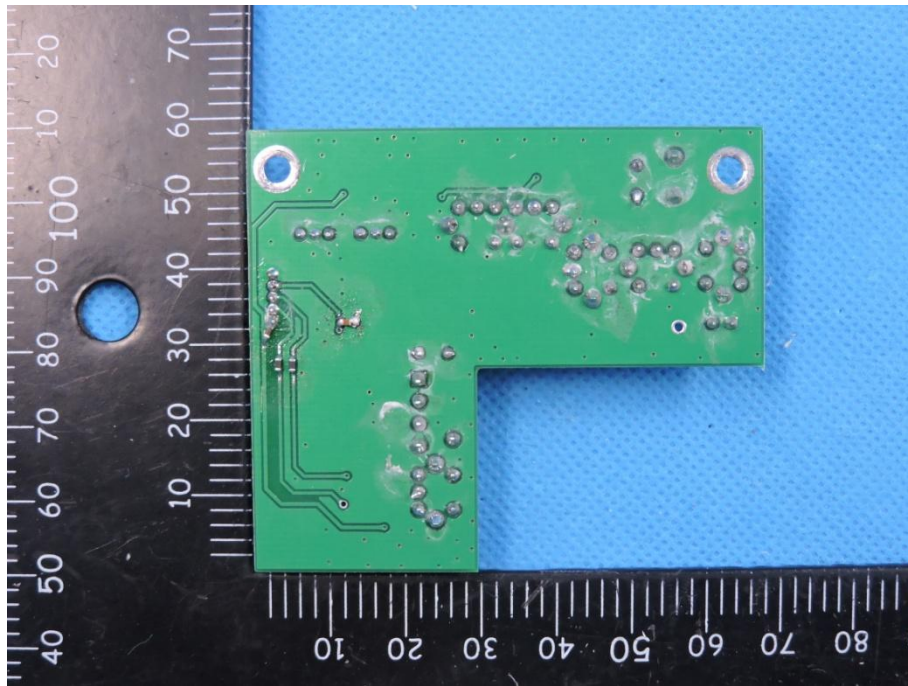


Photo 16

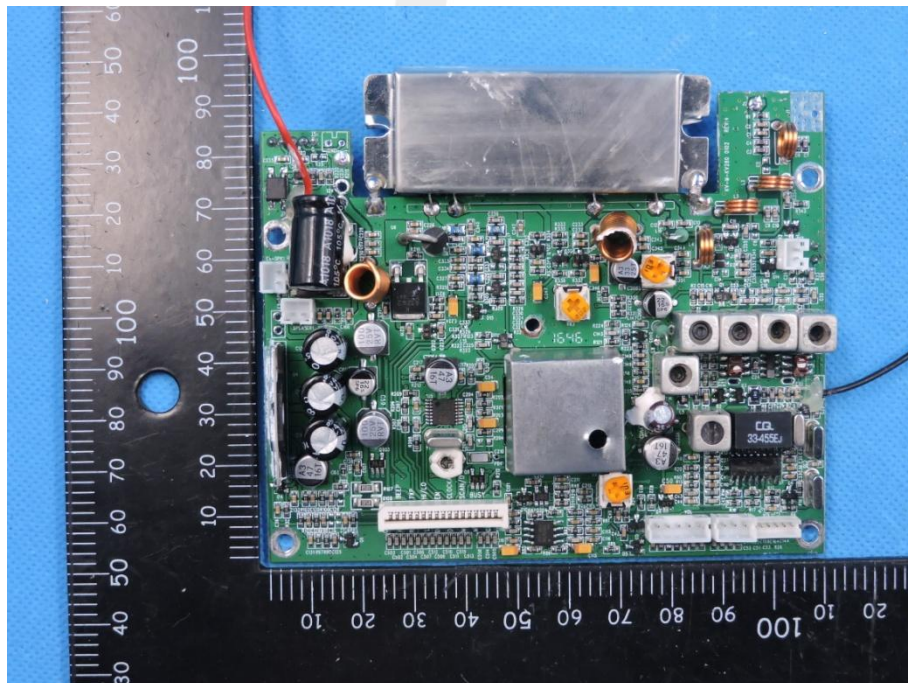


Photo 17

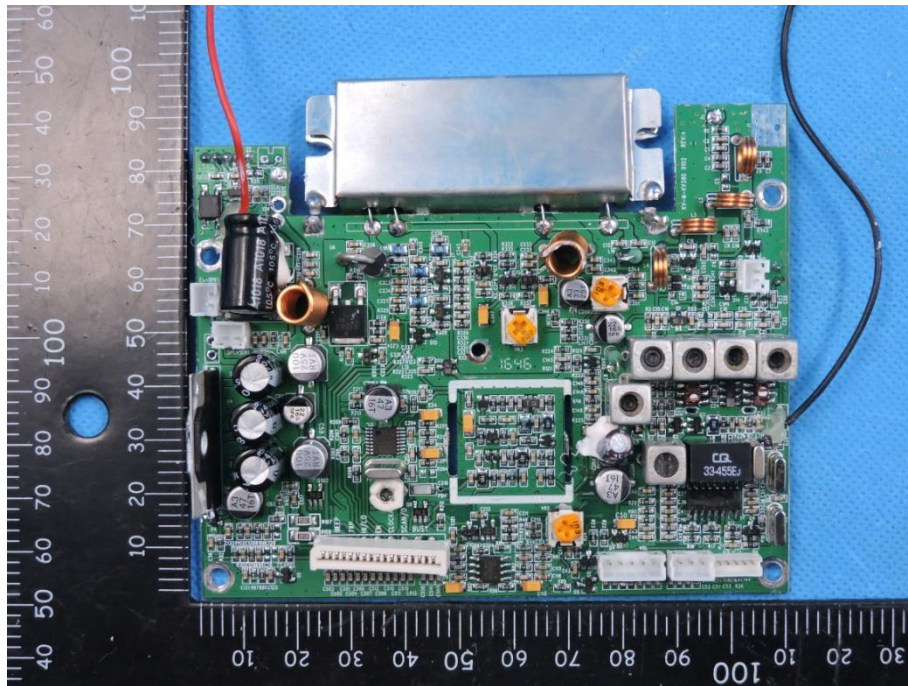


Photo 18

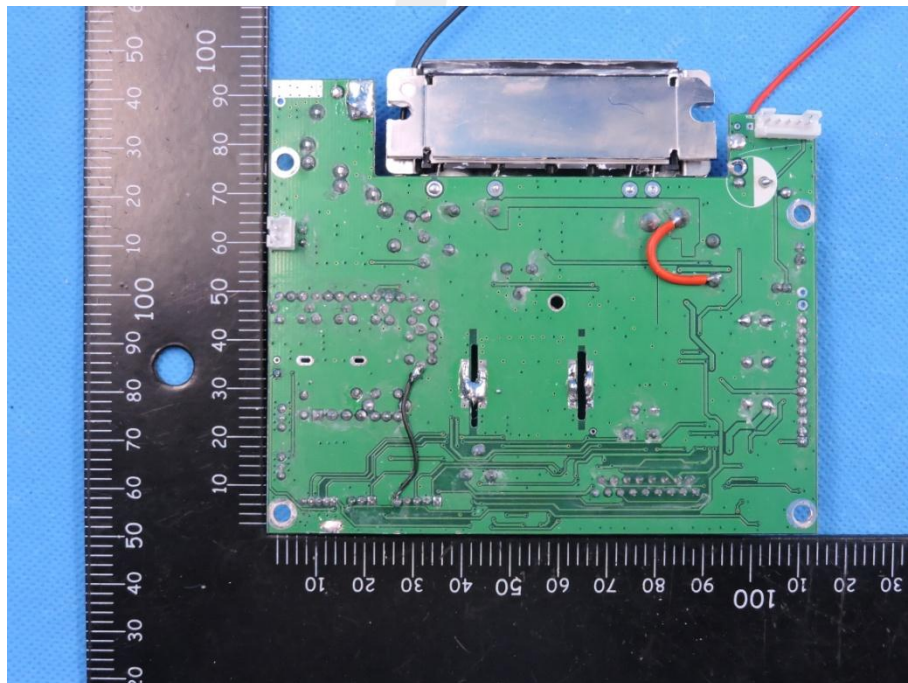


Photo 19

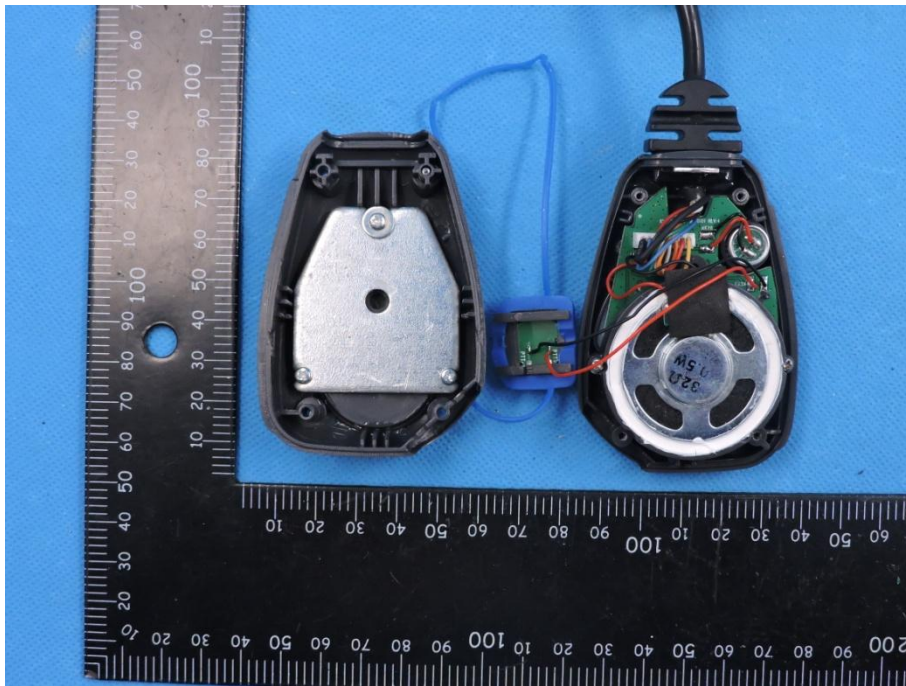


Photo20

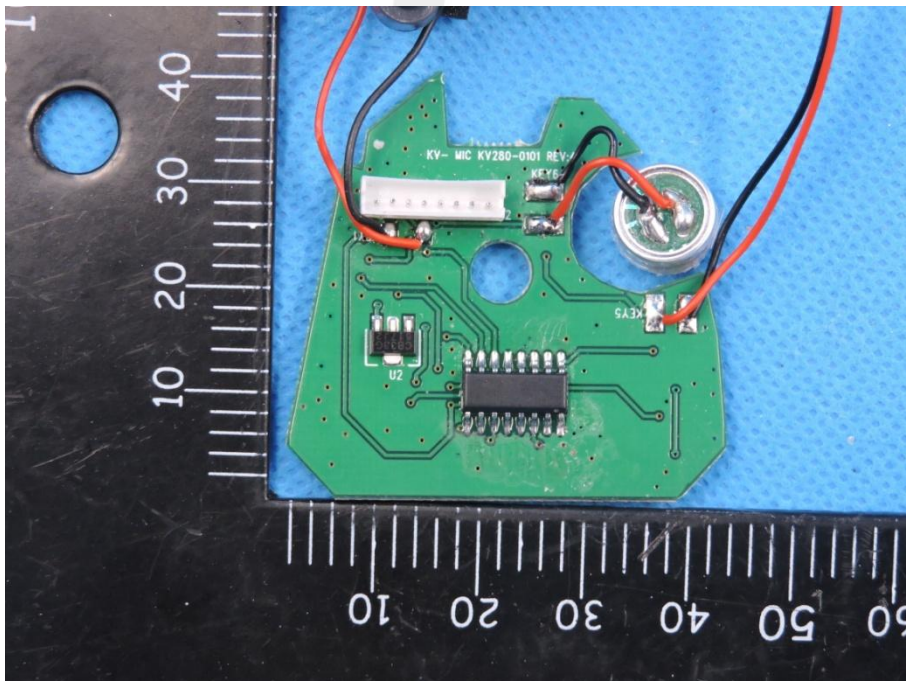


Photo 21

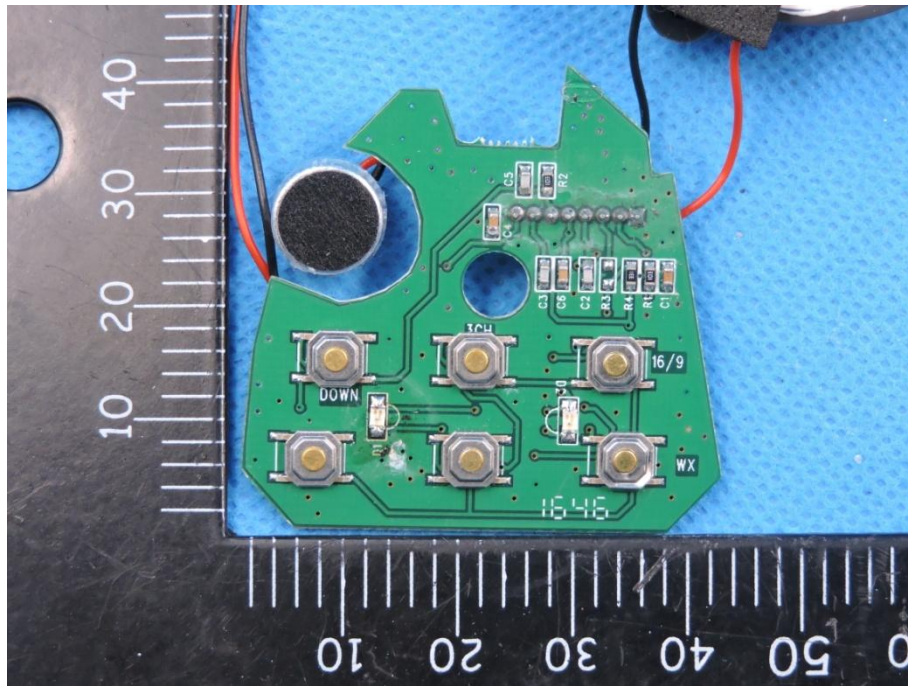


Photo 22

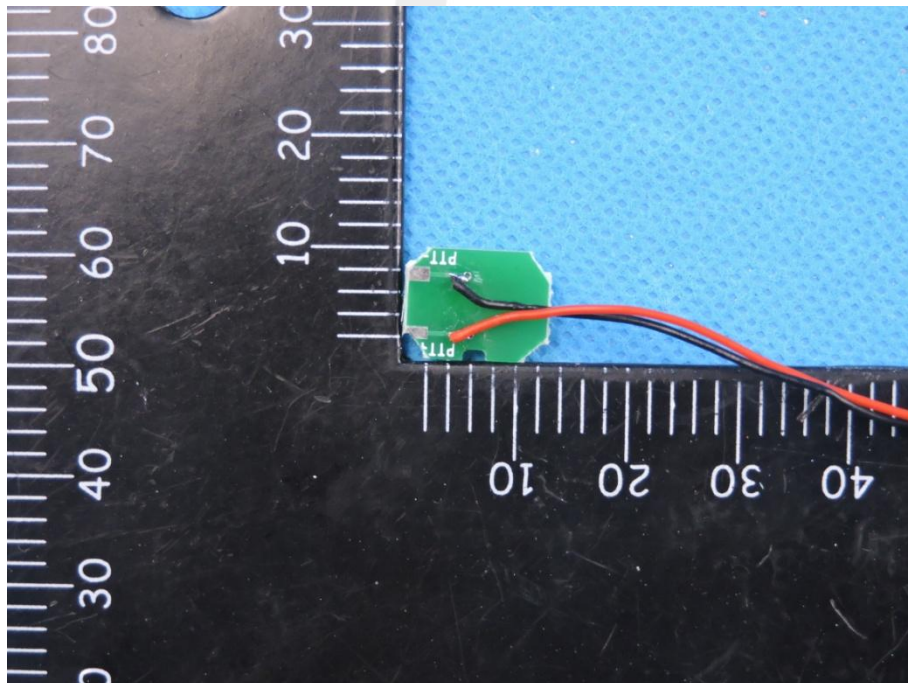
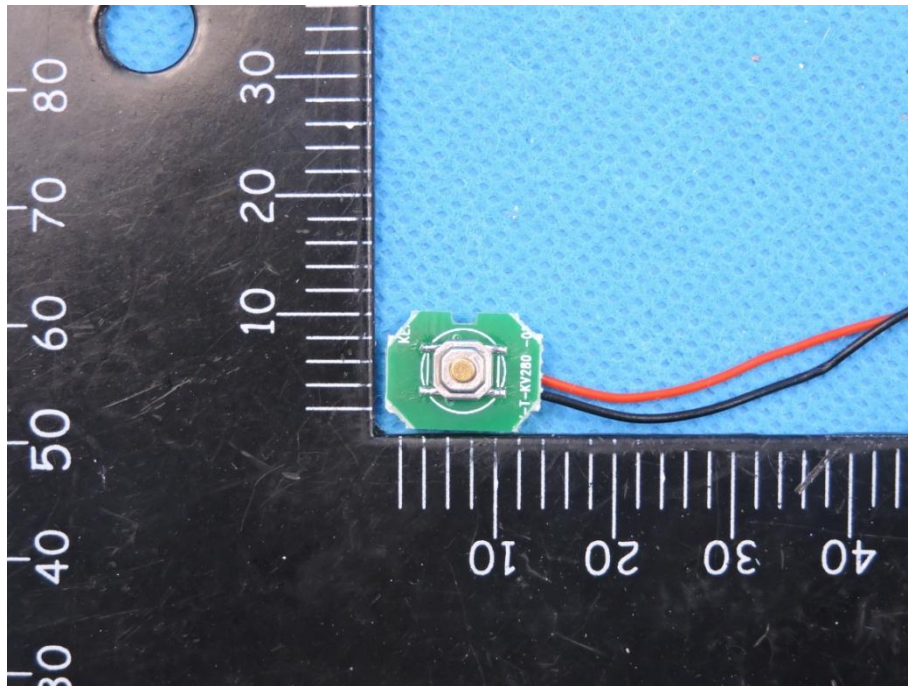


Photo 23



*****END OF THE REPORT*****